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AUTOMOBILE SHOWS.

We make note this week of no fewer than three automobile shows and races. It must be evident, as was already noted in these pages a few weeks ago, that this feature of pushing the new industry is being overdone. Only the affair at Chicago appears to have been at all worthy the consideration of the manufacturers. In the case of the other two meets in New Jersey, the automobile feature, while doubtless a good drawing card, was not of such a character as to repay either the promoters or the competitors for the trouble and expense. It is certainly desirable to draw attention to the automobile in every legitimate way, but evidence goes to prove that there is little real attraction for the public in the mere sight of two or three machines chasing around a track. Moreover, the manufacturers know that such contests usually prove little or nothhing.

In a great city like Chicago, the automobiles can be got together in fair numbers without much expense or difficulty. At such places as Trenton or Guttenburg it is different. They are remote from the factories, and the roads happen to be simply abominable. Anybody who has tried the road between New York and Trenton is not anxious to do the journey twice in an automobile. This is perhaps equivalent to saying that automobile races and shows outside the great cities should wait until the roads are better. We confess that we would much rather see money spent in missionary work for good roads than in automobile cups and stakes.

MUNICIPAL ELECTRICIANS.

The meeting of municipal electricians this week at Pittsburg is an evidence of the increasing importance of this class of public officials. As a matter of fact, it is not easy to see where their influence or responsibilities will end, and even to-day many of them are charged with the care and supervision of apparatus in almost every branch of the electrical art. This, while encouraging and gratifying to a man of ambition, carries with it dangers, for he is a rare man to-day who can fairly claim equal competence in all the widely different fields of electrical engineering. The underlying principles and theories may be much the same; indeed they cannot well differ; but when it comes to practice, the conditions are very unlike.

There are two distinct tendencies visible. One is to create a number of new municipal electrical services and put them all under one department. The other is to supervise private work and regulate it, just as is done by the elaborate rules which reach us this week from the department of public buildings, lighting and supplies of Greater New York. The larger task is likely to fail of accomplishment by its own weight and bulk. The other, that of control, is rapidly becoming a general function. In any event, municipal electricians see their importance grow in the community as the art advances, and it is well that they should get together to exchange experience and harmonize the requirements that are enforced in the various sections of the country.

THE BRITISH ASSOCIATION.

It is very rarely that the meeting of the British Association fails to be of interest, and this year the proceedings of that body appear to have been well up to the average. The attendance of members reached the notable figure of 2000. We wish the American Asso-

ciation for the Advancement of Science could in some way impart into its affairs the vigor and success that steadily characterize the work of the older sister society. There is at least as much good material here to work upon, but somehow the same enthusiasm is never aroused, and some of the meetings have been very near failure as to numbers in attendance, general interest and actual importance. We understand that many Americans went to Bradford this year. Perhaps when they come home they will tell how the thing is done so well over there.

PIONEER RAILWAY WORK.

The interesting article that Mr. John C. Henry has contributed to our pages this week has not only value as an authentic record from a leading actor in great events, but to us is full of pathos, which the author doubtless felt himself as he penned the lines. It is a fine thing to be a pioneer, but the pains and penalties that go with it are often more than flesh and blood can endure. To-day, in balmy Colorado, Mr. Henry nurses the physical wreck with which he emerged from his trials in Missouri and California. If perchance he has enough to live upon, no thanks are due to Kansas City, where his pioneer work lying at the very roots of the modern street railway art was done. Kansas City grudged him bread, and we have not yet heard that she proposes to give him a stone. When the great convention of the American Street Railway Association meets within her gates next month, it may be worth her while to remember that the splendid industry thus typified was due in large measure to the unpretentious telegraph operator whose quiet courage and native genius, exerted under difficulties in a crude frontier town, led him so far toward the perfection of the methods and principles of the trolley street railway system, now conquering the globe.

Mr. Henry is generous in his appreciation of what the other pioneers did in this country, but he and they can afford to speak well of each other, for as time rolls by it is clearly seen that one man only complemented and supplemented the other. It is not at all unlikely that at no distant date few traces will remain in actual use and practice of all that they dreamed and planned and achieved. But as with the beautiful steam locomotive of to-day, it is by the ceaseless efforts of many fine minds that these perfect productions of human genius are wrought; and were it not for that which has gone before, we should not have that which comes after.

"ALSO RAN."

It is said that of the eighty thousand exhibitors at the Paris Exposition, some forty-thousand odd have received awards. To be more exact, the number of exhibitors was slightly over 79,000, while the official list of awards, in our possession, of 320 closely printed pages, enumerates about 45,000 prizes. It would seem that the juries had been chary, for these prizes are now being supplemented by personal honors in the shape of grades in the Legion of Honor. As a matter of fact, the jurors did their duty and worked hard, and there can be no question that in a great many instances the awards were well earned. They were certainly well distributed as to nationality, and the 1500 Frenchmen who served on the juries must have been a broad-gauge, impartial set of men. Although England was conspicuous by her absence, she fared even better than other countries. As for the United States, it is curious that in all the technical classes in which she is conspicuous by number and quality, she stands at the foot of the list in the number of "grand prizes" and "gold medals" awarded, per number of entries. The inference might be that the interests of our exhibitors were not looked after in electricity and machinery, and, as London *Engineering* says: "It is somewhat remarkable that the United States should not have taken a higher place than she has done in any of these comparisons." Another inference might be, however, that it is better to be "ugly" and not make many exhibits, for the United States, though "short" on awards, comes next to France herself in the number of exhibitors.

It is perhaps when one turns to technical publications that the most curious and amusing anomalies press themselves upon one's notice. In the Liberal Arts section some two or three hundred American journals were massed together and their bound files exhibited in a neat but not gaudy bookcase. This exhibit has been awarded a Grand Prix, and each exhibitor has been notified that he can flaunt that Grand Prix as his alone, in the eyes of a dazzled public. The company issuing the ELECTRICAL WORLD AND ENGINEER has three of these gold bricks, and hardly knows what to do with such an embarrassment of "articles of Paris." For one of its journals also it has been awarded a silver medal, although as an actual fact the bound volumes have never left the packing cases in which they were shipped to France. It can readily be imagined that we view that hard-earned silver medal with a tender and sacred regard. The volumes would, it is true, have been shown in their proper place, but a close search for their receptacle at the proper time failed to reveal it; and so the volumes will come back "in the original package." Presumably if they had never been sent, two gold medals would have been the award, for even now it is an exploration in Darkest Africa to find the place where they would have been separately "exhibited." The Roentgen ray penetration of that jury is one of the marvels of the great Show. But what shall we do with the silver medal, and what would we have done with a gold medal, when we hold three gorgeous Grand Prix, which outrank them, according to London *Engineering*, as 25 is to 20 and 15? Moreover, in a third instance a collective exhibit of our publications displayed at our headquarters in Electricity Building was put literally "hors concours" because one of the French jurors also publishing a paper was for some esoteric reason, political, perhaps, not allowed by his own Government to exhibit it; and therefore he would not agree that American publications should even be considered. This has a dog-in-the-manger air about it, but what difference does it make to us when we have three Grand Prix? Why we should be allowed to fill up one space with three journals and exhibit also in two other places, while our charming French confrere was not allowed to get even the tip of his nose into a single building, is one of the many enigmas of the Exposition of 1900. But, to say the least, it would prove that France did not want all the space for her own children.

It is sad to see that some of our multitudinous American contemporaries who "also ran" are rather pluming themselves on their "Grand Prix" or their gold medal. Far be it from us to cast even the suspicion of a shadow of gloom over their unsuspecting joy. The love of a chromo is deep-seated in human nature, and the polite desire in Paris to satisfy it is not to be lightly condemned. We note, however, that our esteemed contemporary, the *New York Commercial*, in discussing this right conferred on a few hundred papers to announce and parade the Grand Prix, says: "Naturally only the most insignificant class of publications would care to take advantage of this privilege, and if any should do so, the absolute ridiculousness of the award would thus be only the more sharply emphasized." Alas! those journalistic prizes of 1900 must pass into obscurity with the straw hats of the summer that is past, and not be blazoned on the ancestral walls with the helmets whose oriflammes have gleamed in the front of glorious victory.

EXPANDING CABLEGRAMS.

The Institute of Journalists, an English organization which has just been in conference in London, resolved, among other things, to appoint a committee whose duty it is to investigate charges against papers manipulating items of news or unduly expanding telegrams. The committee has a serious task, but one worthy its best efforts if

approached in the right spirit. It is probable that as a rule the public prefers expanded cablegrams, if the work has been done with care and intelligence, just as it prefers good hot soup to a dry mouthful of Liebig's extract. But, in reading sense into a cablegram, it is undesirable that the cable editor should read things that are not there and that are not so. It is of equal imortance that when the Zulus take umbrage, the incident should not be scare-headed as the capture of a town, and that a seismic disturbance should not be put into a sensational headline as more trouble with the Jews. Incidentally, the committee might spend a prayerful hour with the cable operators. The messages from China and South Africa have been exasperatingly full of gaps, unreadable passages and bulls. The poor cable editor is entitled to a little mercy at the hands of his brethren.

ELECTRICAL DISCHARGES THROUGH GASES.

An interesting paper has recently been communicated by Prof. J. J. Thomson to the Cambridge Philosophical Society and Philosophical Magazine, on the subject of "The Genesis of Ions in the Discharge of Electricity Through Gases." It is shown that gases which are ordinarily electrically non-conducting become conducting owing to the presence of ions in them. These ions may be formed in gas by a variety of influences, such as the action of Röntgen rays, but there is reason to believe that a few ions are always present in gases. The same belief has for some time been maintained in regard to liquids. Individual ions are always accidentally present in small numbers and they are by their very nature always electrified or carry electrical charges. An electric field such as is formed in a dielectric in the presence of an electrified conductor exercises an electric force upon such ions in virtue of their electric charge and urges them along the electric lines of force. Prof. Thomson points out that there is reason to believe that when a moving ion collides with a molecule with a certain velocity, or momentum, the molecule is decomposed into a positive and a negative ion, and these again are capable, under the action of the electric field, to create new ions by impact. When the electric force is not sufficiently strong to produce the required velocity, new ions are not formed. Thus an electric force brought to bear upon a layer of gaseous dielectric, such as air, is believed to develop an increasing number of ions as soon as the electric field arrives at a certain critical strength. In this way the layer of air becomes partially conducting and disruptive discharge occurs.

Since the momentum which an ion can acquire under a given electric force increases with the distance through which it moves under that force, just as a heavy body acquires a momentum in proportion to the distance through which it falls under gravitation, so the length of the mean free path of the ion determines the power which it has of attaining the critical velocity under a given electric force. The longer the free path the greater the mean velocity acquired before the ion has made a collision and delivered its blow upon a neighboring molecule. Consequently a given intensity of electric force should be able to bring about ionization and effect disruptive discharge more readily in low-pressure gas where the mean free path is relatively small. Experiment shows, in fact, that the electric force required to effect disruptive discharge in a gas, varies nearly inversely as the density of the gas, over a considerable range of density. A number of other phenomena point to the same conclusion; namely, that moving ions beget ions at and above a certain definite velocity.

In the case of vacuum tube discharges, the striæ are shown to be capable of explanation on the same hypothesis. Ions moving under the terminal impressed electromotive force generate new ions, but they do this in a manner that is essentially variable and rythmic. In a given space the new ions tend to improve the condition of the gas and thereby to lower the local electromotive force down to the point at which no further ions are produced; the dissipation of the ions then gives rise to an increase in electrostatic force and a redevelopment, and this action may continue rythmically for an indefinite time.

The production of ions in gases seems at the present time to have no attractions for the electrical engineer. In the incandescent lamp the effect is baneful, since it may give rise to a short-circuiting, such as actually occurs at abnormally great pressures. Disruptive discharges are always to be regretted in electrical engineering, owing to the short-circuit which may follow them, and even if no disruptive discharge occurs, the local ionization which may occur at the surface of high-pressure conductors gives rise to electric convection and waste of energy from them.

ELECTRICAL THEORIES OF GRAVITATION.

The article by Prof. Fessenden, in this issue, calls attention to the hypothesis which has recently been developed by J. J. Thomson and others, that the atom is not the *mimimum divisible*, but that an atom is really a complex of a great number of smaller masses called corpuscles, each of which is an ion when detached from the atom mass. In this manner, as has already been pointed out by Prof. Fessenden in these columns, the inertia of matter may be explained on purely electrodynamic reasoning, since the accelerated motion, through ether, of electric fluxes of these intensities and total magnitudes, would necessarily give rise to magnetic retarding forces proportional to the acceleration, just as inertia forces are.

It is now suggested that an electric charge produces a local reduction in the density of the surrounding ether, and that, in accordance with existing theories, such reduction in density would account for gravitational forces. In other words, each corpuscle of matter resident in the atom acts with its inseparable electric charge to reduce the density of the ether in its immediate neighborhood, and consequently each atom, molecule and aggregate mass of matter is accompanied by its reduction in ether density, which diminishes as the square of the distance into all surrounding space. As a corollary of this proposition, Prof. Fessenden concludes that the mass of a condenser is actually temporarily reduced to some minute extent during the period of its electrical charge.

It is needless to say, however, that until experimental proof is forthcoming, such explanations can only be guesses. If the mass of a body is dependent upon the total electrical charge, then it follows that whenever we communicate a charge to a body we alter its mass and weight, although the amount of variation would be so insignificant with the electrical charges at our experimental hand that the effect might be beyond all hope of experimental observation. There can be no doubt that some explanation at least as simple as that which is here offered will be ultimately found and accepted for both inertia and gravitational force. There can be no reasonable doubt also that electromagnetic actions will be involved in some manner with the explanation, if only for the reason that electrification or magnetization seems to be a property of matter as inherent as its mass. All that can be said, however, at the present time, and until further experimental evidence shall have been secured, is that the hypothesis here suggested is both ingenious and simple, and as such has claims to be considered and refuted if it may be. We may safely consider, however, that electromagnetics will soon be so intimately associated with the ultimate phenomena of molecular activity, both chemically and physically, that the existing limits and bounds of these various sciences must disappear. Meanwhile, we want more measurements upon the properties of ions and more experimental facts.

Bradford Meeting of the British Association.

The British Association for the Advancement of Science has just closed at Bradford one of its most successful annual meetings. Over 2000 members were present and a large number of interesting and valuable papers were presented. Bradford was visited by the association 30 years ago, since which time its population has doubled and it has prospered hugely as an industrial centre. A number of Americans were present at the meeting.

It is the practice to have a popular lecture to artisans in connection with the annual meeting, and this year the topic was "Electricity in the Industries," treated in a most brilliant manner by Prof. S. P. Thompson, who received a magnificent tribute of appreciation at the close of his experimental discourse. Touching upon electrical power, he gave a striking example in the case of Messrs. Siemens, who, when they reconstructed their works some years ago, turned out 12 steam engines and put in one large steam engine to drive big dynamos. With 86 motors of from ¼-hp to 100-hp—with a total horse-power of 12,000—they saved 3000 tons of coal per annum, as well as the wages of six stokers and engineers. One firm in Berlin employed 16,000 people, and every single piece of machinery, every tool, was electrically driven. Again, as to high and low pressure stations, he said that the cost of copper wire required to convey a pressure of 100 volts 100 miles would amount to £67,000,000, a pressure of 10,000 volts would only cost £6700, while if it could be increased to 100,000 volts the cost would be reduced to £67. "If we have not the water power in this country," he said, "we have the coal fields, and if we would economize our stores, the coal must not be wasted by being burnt in little steam engines or by using shafts and belts which absorb 25 per cent of power. Let us economize our supplies. Let us not try to do on a small scale that which can only be done economically on a large scale. If you would have power generated economically in this country it must be done by going—not to that which we have not: the water-falls—but by going to the pit's mouth. There burn your coal, and save the cost of transit. Do not burn it in small steam engines. Burn it under the boilers of large engines. Make a good, economical, non-illuminating gas, and use that gas to drive large gas engines, which are successful up to 500 and 1000-hp. A 1000-hp gas engine, provided with good economical gas, will give power day in and day out, 24 hours in the day, and 365 days in the year, at the rate of £4 per horse-power per year; and you cannot get that by a small steam engine."

During the week of the meeting a number of interesting papers in physics, mechanics and electricity were presented. Some of them will appear in abstract in these pages. One of the papers in the section of mechanical science dealt with trolley omnibuses, the author being Mr. J. W. G. Aldridge, who proposed automobiles taking current by trolley contact from live wires, in a manner now more or less familiar. The great difficulty in the extension of tramways, he said, is the cost of the permanent way, which will not be less than £4500 per mile of single track. Assuming a 5-minute service each way for 16 hours a day, maintenance at ½d. per car mile comes to £271 2s. 4d. per annum, while interest on £4500 at 3½ per cent is £157 10s., making a total of £428 12s. 4d. per mile, excluding all provision for repayment of capital. The cost of track maintenance varies from £35 to £530 per mile; in Boston, U. S. A., and several English towns, it exceeds £500, while in Hamburg it is as low as £130. In the towns and districts under consideration this heavy charge for upkeep is likely to seriously reduce the profits on working. The experience of rapid and smooth transit in the electric tram car has sealed the fate of the omnibus of the ordinary type, and already some of the omnibus companies, recognizing this, are making substantial improvements in their vehicles. The working expenses are also heavy, no less than 8d. (16 cents) per omnibus mile in one large town, which may be taken as a typical example. This gave the opportunity for trolley omnibuses.

Sir W. H. Preece, F.R.S., read a paper on the Manchester and Liverpool Express Railway. A monorail line has been projected by Mr. Pehr between Manchester and Liverpool to accommodate express passenger traffic alone between these two cities. It is to be worked by electric traction and to attain very high speeds. The train is to consist of only one coach weighing 45 tons and seating 64 passengers. Starting at every ten minutes, and traveling at the mean rate of 110 miles an hour, it will do the distance of 34½ miles in 20 minutes. The monorail railway was projected by Lartigue in 1882. There was only one example of this system of railway in the United Kingdom, viz., between Listowel and Ballybunion, in County Kerry, Ireland. This line was designed and engineered by Mr. Behr. The line was opened for traffic in February, 1888, and it has been running ever since. The line is 9¼ miles long. There are 42 level and farm crossings. It is worked by steam. The train consists of a locomotive and four coaches. It cost £33,000 to build, or £3060 per mile. When Sir W. H. Preece inspected the line in the early part of the year there had never been a Board of Trade inquiry into any accident. The maintenance of the structure had been effective. No rail had ever been turned. The mechanical structure had exhibited no defects, but several breakdowns had occurred in the locomotive and rolling stock. There are 3 locomotives, 11 passenger coaches and 2 brake vans. They had, however, continued to work the line uninterruptedly for 12 years, and there had been no renewals or new stock. Its main principle is the suspension of the coaches on a single elevated rail so that their centres of gravity are below the rail. Each coach sits the rail like a saddle. The rail is fixed on trestles which are tied and braced together, the tie bars being light rails against which guide wheels roll. The Manchester and Liverpool express is intended to be more massively and rigidly built. Derailment on such a structure is impossible, and curves of comparatively small radius can be passed with safety at high speeds. Vibrations and noise will be reduced, and traveling will be conducted with greater comfort than at present. It is proposed to fix the generating station midway, at Warrington, and to transmit the electric energy at high pressure, 10,000 volts to each terminal station. There would be sub-stations along the line at distances apart of 4 miles where the 10,000 volts would be brought down to 1000, at which pressure it would be picked up by the motors on the coach. A coach weighing 45 tons can easily and quickly attain 110 miles an hour.

Mr. T. Barker read a paper to illustrate a meter which, in conjunction with Prof. Ewing, the author had devised for the purpose of registering the maximum current taken by consumers of electricity. Until the introduction of Barker and Ewing's demand indicator it was necessary to use two meters—one to record the total number of units taken by the consumer, and the other to show his maximum rate of demand. The Barker and Ewing indicator forms an integral part of the ordinary meter, and absorbs no energy; it further records watts and not amperes. With an alternating supply it shows actual watts and not apparent watts, an important difference in the case of motors and arc lamps. It is not affected by any ordinary short circuit, its time lag being sufficient to prevent it coming into action. The indicator may be used to show the actual rate of demand at any instant, in place of recording the maximum rate of demand. In this form it is specially useful in switchboard instruments, showing the attendant the rate at which electric energy is passing through a feeder or is supplied from a dynamo at any instant. The meter also serves at the same time to integrate the total amount which has passed through that particular feeder or machine.

A paper was presented by Mr. Alfred H. Gibbings, the former city electrical engineer, on "The Design and Location of Electric Generating Stations." All design and arrangement in regard to electrical works must be with a view to securing the highest average efficiency together with reliability in operation. Such plants at present do not fulfil these conditions, but that may excusably be accounted for because it was impossible to foresee modern developments. Generating works must in future be constructed and located with a view to include the supply of energy for motive power, tramways and electrochemical purposes. Details of such construction and location should embody the following points: (1) The machinery must be designed to generate at high voltage, differing according to the extent of the area and the nature of the system, but it must be suitable for transformation at sub-stations to meet all possible requirements; (2) the type of all boilers, engines, electric generators, switchboards, etc., must be simple and mechanically reliable, even at the sacrifice of some slight maximum economy; (3) all complicated gear and fanciful combinations, such as might lead to possible breakdown, must be avoided throughout the entire arrangement; (4) as far as possible the different units of the respective types of plant should be uniform in design and arrangement and made to one standard size, thus economizing in labor, avoiding large "stand-by" plant and spare gear; (5) the buildings should be devoid of all unnecessary embellishments, nor should an attempt be made to confine too many departments under one roof; (6) the location should be such as to insure a cheap and ready supply and delivery of fuel, and where condensing can be accomplished efficiently and inexpensively.

A paper was presented by Mr. C. S. Bradley, of New York, on some new chemical compounds discovered with the aid of the electric furnace. The sixth report was presented from the committee on electrolytic methods of quantitative analysis.

Pioneer Electric Railway Work in Kansas City.

BY JOHN C. HENRY.

J. C. HENRY.

IN view of the approaching convention of the American Street Railway Association at Kansas City, I am pleased with the opportunity afforded me to record in the hospitable pages of the ELECTRICAL WORLD AND ENGINEER a brief history of the early electric railroads constructed and my connection therewith. Some sixteen years ago the late Judge Wm. J. Henry, a celebrated author and lawyer, then residing in Kansas City, projected a railway to be constructed in the interests of some real estate, and to connect Kansas City with the county seat, Independence, a town some ten miles away. About the same time, the judge had discovered in me a second Edison, and he readily accepted my suggestion to make the proposed road an electric one, to be constructed under designs and inventions which I had been canvassing over for some years. At that time there was very little to copy from. Electric traction occupied then about as forward a position as aerial navigation does to-day. Siemens had led the way in Germany by exhibiting at the Berlin exhibition in 1879 an electric locomotive capable of hauling a few passengers. This locomotive had divided axles. It took its current from one of the track rails, and the circuit returned to the dynamo by the opposite rail. Edison and Field took the subject up in this country. They used a third rail, but failed to develop anything of a commercial nature. In the meantime, Siemens, in Germany, put in commercial operation a small road where slotted iron gas pipe was used as a working conductor. This was supported overhead by a light bridge structure. The contact was made by a small collector sliding within the pipe. Connection was made therewith by a wire which passed through the slot and led to the car.

Along in 1883 and 1884, Mr. Leo Daft and the late Charles J. Van Depoele investigated the subject in a practical way substantially on the line of Siemens' earlier work. During these same years, Messrs. Bentley and Knight built on one of the streets of Cleveland an experimental underground conduit railway. This, by the way, was the only electric railway exhibit open to the public in America when I started to build the first electric road in Kansas City, which was constructed to demonstrate the advantages of electric traction to the owners of the proposed Independence road. This little road seems to have done much towards the introduction of electric traction. For years its principal features were followed in nearly all constructions. With all of the prior inventions, the involved problem was where and how to insulate and locate the supply conductor, and how best to maintain traveling contact with it, so as to leave the roadway clear of obstructions. The plan to suspend the conductor (a large wire over the track) by span wires which were supported on the side of the road and to leave the under side of the wire free so that a traveling contact might be maintained therewith, was introduced. The road referred to was a west end portion of the track of the Westport Street Railway, then owned by the Holmes Brothers. To encourage our demonstrations, Mr. Walton Holmes, the present president of the Kansas City roads, loaned us a two-horse car and the use of the track, besides contributing financially towards the experiment. The track rails weighed but 12 lbs. to the yard, and had been laid a dozen years before by Mr. Holmes' father. The first car was named "Galleaza," Galvani's wife's maiden name. She was really the first to discover electro-magnetism by observing the frog's legs move in the presence of an electric current.

The car was open, and had seats down through the centre facing outwards, like an Irish jaunting car. The motor was a 5-light Van Depoele generator and developed about 5 horse-power. It was mounted in an iron frame with variable speed-changing gear, which was supported at one end on the car axles and engaged with gearing thereon. The front platform had been lowered, permitting the commutator end of the motor to project thereon, and to be spring supported. The motor was series wound, and regulated by resistance. Our power was supplied by a portable threshing engine driving a 10-light Van Depoele dynamo. We had double overhead wires supported both by bracket and by span wire construction.

The wire was No. 1 gauge of hard drawn copper. The longest I could get made was in 60-ft. lengths. We brazed it together on the ground before starting construction. I had visited the East to see what material and apparatus was available. I got very little encouragement from the manufacturers. I remember being informed by the president of one of the largest electric manufacturing companies that I had lots of assurance—that if my people had money enough to buy copper mains as large as his thigh (and it was a great big fat one) they could build our motors. It may be needless to say the gentleman now occupies a minor position.

I think the name "trolley," as applied to overhead wire roads, originated on my Westport road. Our first traveling contact was a little four-wheel carriage which gripped to and ran along the underside of the wire. It was attached to a flexible cable and was trollied along by the car. At first it was called a "troller," but the name was changed to "trolley" by the employees or public, certainly before any overhead wire trolley lines were constructed.

After making our demonstration, it appeared clear to all concerned that under proper conditions which seemed available electric traction could be depended upon for street railway work, and that it was capable of supplying many of the short-comings incident to animal traction. In the spring of 1885 Mr. Van Depoele came out to investigate our plans, and to sell us more machinery. If he had any previous doubts about electric traction, they were dispelled. He thought I had hit upon an easy solution to the vexed problems, and shortly afterwards he began to boom the business. His efforts were very successful. They had been rendered possible by my inventions in the span wire, curve and feeder methods which have been followed in nearly all subsequent construction.

I remember meeting Mr. Henry A. Pevear, then president of the Thomson-Houston Company, in San Diego, Calif., during the summer of 1888, where I had constructed and was operating some roads. He gave me the news about electric traction in the East. Among other points, he mentioned that his company had recently acquired the Van Depoele electric railway patent interests. Before doing so, they had sent disinterested experts to inspect and report on some sixteen different Van Depoele roads scattered over the country, and in every case they were favorable. At the same time he gave me my first information about Mr. Sprague's work at Richmond. This was before the latter road was in operation. In the meantime, Mr. Daft had constructed and maintained in operation a third-rail road in the suburbs of Baltimore. This road was kept in operation for years, and did very much towards maintaining confidence in electric traction.

In the fall of 1885 I secured heavier machinery and moved from the Westport road onto some steam railway tracks owned by the Fort Scott & Gulf Railway Company. Here we experimented at high speeds and in hauling freight cars, etc., and in testing our car on the grades and in the snow. Railway men then seemed to have no fixed ideas about adhesion. I remember hearing the foremost cable railway engineers in the country, assure the president of the Kansas City cable company that it was impossible to run cars with self-contained power up a 7 per cent grade, *because the wheels would slip*. Such fallacious remarks and other misrepresentations about the electric motor, all of which could have been easily determined by tests, opened the way for cable traction, with all of its attending monumental financial and engineering blunders.

In the winter of 1885 and 1886 we arranged to equip the East Fifth Street Railway in Kansas City. It had but a mile of track completed, and extended from Grand to Lydia Avenues. We had four motor cars. They were open, and similar in appearance to cable grip cars. They had but a single 25-hp motor attached to one axle. It projected up through the car. Its working parts were in view of the motorman. It was connected to the axle by a planetary gear. The car was operated by two vertical levers, one to apply the regular friction wheel brakes, the other to connect or disconnect the motor from the car. The armature ran constantly. The motor was a slow-speed machine, the armature being 18 ins. in diameter. It was built up of laminated iron and had Pacinotti projections. The fields were wound with a multiplicity of small parallel wires bunched together permanently at one end. The free ends terminated in switch contacts, so that the resistance of the fields might be varied and the motors be regulated without resistance. Our station was arranged for 500 volts, which was a potential considered safe by electric light men and ample for our purpose.

In 1887, I contracted to build several roads in Southern California. We made all of the machinery in Kansas City by rule-of-thumb methods. It served its purpose for several years. Those roads, however, had checkered careers, mainly owing to the high price of fuel. During the boom in Southern California our coal all came from Australia, and cost us $22 per ton. It was cheaper, however, than Northern coal at one-third the price.

I think the most important steps in the development of the electric railway were the introduction of the span-wire construction; the connecting a rope to the underrunning trolley so as to make it operative from the rear of the car, and the development of the carbon brush. These were all important inventions, but so simple it is hard now to see any invention in them. They, however, were not made by the technical engineers or electrical scientists.

In 1886 Prof. Sidney Short experimented on the streets of Denver with an electric underground conduit road. The motors were run in series, i. e., telegraph fashion. The car carried a pole somewhat resembling a wagon tongue. It projected forward and made connection with the underground switches. This tongue carried a long insulator, in the shape of a leather strap, which extended to the rear of the car. This strap would open up the spring-jack switches and permit the same current to pass through the motors at various points along the road. The main object was to save copper. The advantages of the series system were enlarged upon and defended by the highest electrical authority, and Prof. Short took the lead in experimenting with it for years. Some amusing stories have been told me about this road. The patrons became accustomed to pay their fare at their destination.

I have referred to the great invention of attaching a rope to the Van Depoele underrunning trolley. On the Montgomery, Ala., and other roads, it was the practice to carry a boy on the roof of the car to care for the trolley. The carbon brush seems to have been developed gradually. Prof. George Forbes used this material as a collector on a smooth surface at an early day. Both Van Depoele and I used it independently for a while in our first machines. I abandoned its use in favor of a comb brush, having my own earmarks. It worked very well on a rough commutator. The commutators on Van Depoele's first motors and mine were insulated with fibre, and would not remain solid, so that carbon brushes chipped off and broke easily. After the Thomson-Houston Company started in the railway business and used their splendid manufacturing facilities and methods in making motors, they used mica for insulation and built commutators very solidly. Then Van Depoele reintroduced the carbon brush with wonderful success.

In 1889 the Bentley and Knight interests were acquired by the Thomson-Houston Company. These gentlemen, after a great deal of persistence, had developed and operated in the city of Boston an underground conduit road which was more of a success than the street railway men generally desired at that time. It was evidently throttled in the interest of the earlier trolley roads, which were cheaper, and, in some respects, better. The principal features of the Bentley-Knight conduit system are as now used in the surface roads in New York and Washington. The Cleveland demonstration with its wooden slot rail, which was kept open by a broadaxe, led the way.

It is evident from a study of the Patent Office records that Mr. Frank J. Sprague did some pretty hard studying on the electric railway problems at an early day. He was the first man with a competent technical education to enter the field. He had been educated in the best government engineering school, had shown originality when associated with Edison, and had made great improvements in stationary motors, and did very much to change the practice of operating them from the constant current to constant potential methods. He surrounded himself with assistants of the highest education, and at Richmond he made a brilliant charge. His extensive undertaking there did much towards attracting attention and interesting capital in electric railways. Then he led the race which resulted in the development of an art whose growth is without a parallel in the history of American invention and industrial progress.

Operators in Prussia.

The Prussian Minister of Railways received a petition in July from telegraph operators who wanted their salary raised. The result was that he engaged in their places a large number of women at 50 cents a day.

An Explanation of Gravitation.

By Prof. Reginald A. Fessenden.

I HAVE recently found that the attraction of gravitation can be quite satisfactorily accounted for by a secondary electric effect. The agreement does not only extend to the nature of the effect, but also to the dimensions of it, so that there is little doubt that it is the true explanation.

The theory will be given more fully elsewhere, but the present short note may be of interest.

The modern theory, that electric charges are not alone confined to charged bodies or to bodies carrying currents, or accompanying chemical changes, but form an integral part of the atom, and are always present, even in the case of neutral atoms and the atoms of such substances as those of metallic copper, was originated by me, and was first published in the columns of *The Electrical World*, Aug. 22, 1891. Previous to these papers there is no record of the idea having been put forward, and still less of any evidence in its favor, such as was given in the papers referred to. In fact, the general trend of thought at that time was so opposed to it that the paper (in a much more extended form than that in which it appeared in *The Electrical World*) was seeking publication for very nearly a year before it finally was put in print in abstract form. It was urged at that time by its objectors, that the atoms of a metal, such as copper, must conduct, as otherwise the metal itself could not conduct, and that consequently the presence of equal positive and negative charges on such atoms was impossible. It was also urged that it was a fundamental principle in electrostatics that all charges must reside upon the outside of conductors, and hence such atoms must be really devoid of charge, and not merely neutral in the sense proposed by the writer. Even the former editor of *The Electrical World*, who was so kind as to give the note publicity, took occasion to point out in an accompanying editorial that the observed phenomena were probably due, not to electrical effects, but to some other molecular force, which gave results of about the same order of magnitude.

Subsequently, however, Richartz, Chattock, Lorentz, Larmor and others have arrived at the same conclusion, and in other papers I have considerably extended the theory. At present, therefore, we are fully justified in accepting it.

In a paper on Conductors and Insulators, No. IV, *Electrical World*, May 6, 1893, I suggested that the atoms might be formed of vortex rings arranged into different kinds of space nets, with the direction of rotation of the vortex rings such as to make these combinations dynamically stable. Previous to this time, so far as I am aware, the atom had been taken as a single vortex ring. The hypothesis advanced was, however, entirely without justification, until J. J. Thomson made his great discovery. We may now, since his work has been corroborated in entirely distinct methods by other observers, feel no hesitation in accepting the theory that the atom is made up in some such way.

Previous to this it had been suggested by several writers, among whom Dr. Kennelly may prominently be mentioned, that inertia was really the electromagnetic inductance due to the charge which the writer had shown to exist on all atoms, even when not carrying a current or interacting chemically. For J. J. Thomson had (in *Phil. Mag.*, April, 1881) shown that the addition of a charge to a moving body increased its inertia. But a short calculation showed that the effect of a charge on the atom is much too small to account for the whole inertia, it being about 10^{-8} times too small.

In Thomson's paper, (*Phil. Mag.*, December, 1899), in which he discusses some of the results of his discovery of the corpuscles, he recurs again to this question, and arrives at the conclusion that the electric charge is a possible explanation, but that at present, having no knowledge of the size of the corpuscles, we are unable to make any definite statement.

Now at the 1899 meeting of the A. A. A. S. I showed that (by means of what I have called Qualitative Mathematics, an extended form of Dimensions) the nature of the electric and magnetic quantities might be determined. This was done, and the density and elasticity of the ether were also determined.* In this same paper (published in the *Phys. Rev.*, January, 1900) it was shown that we are necessarily forced to the conclusion that the cross-section of the atom is very small compared with the space occupied by it. It must be at least, according to

*I have since found that the result there given may be obtained in a different way, by considering the powers with which the forces can enter into some Lagrangian terms when the values of the permeability and specific inductive capacity are changed. The nature of electricity and magnetism may now be considered to be definitely settled.

the experiments therein described, less than one-quarter per cent of the cross-section occupied by the atom.

Without this result we would have no reason for supposing that the corpuscles might not be almost of the same diameter as the atom, for if they had 10 per cent of the diameter of the atom, there might still be one thousand of them in the atom. But, taking this result, obtained from quite different considerations, in connection with Thomson's result that there are at least several thousand corpuscles in the atom, we see that the diameter of the corpuscle must be much smaller than that of the atom, and hence, as this gives us the great inertia effect which we need on the electromagnetic hypothesis of inertia, we are justified in saying that it is something more than a hypothesis, and that it is probably the correct explanation. This I have pointed out in a previous note.*

Now comes in an extremely interesting point. In the paper referred to (A Determination of the Nature of the Electric and Magnetic Quantities, and of the Density and Elasticity of the Ether, *Phys. Rev.*, p. 109, 1900) I called attention to the qualitative equation,

$$M/L^3 = T^2/L^2 \times M/LT^2,$$

and stated that the phenomenon represented by it, *i. e.*, that the specific inductive capacity varies as the inverse second power of the voltivity, and as the elasticity, has not yet been discovered. I have found, though the experimental results definitely establishing that fact may not be published for some years, and my statement must be qualified to mean that I have done enough to render the result fairly certain, that it is the exact formulation of the discovery of Quincke, that all dielectrics change volume under electric stress, combined with an additional discovery of mine so that we may make the following statement:

All simple dielectrics expand under electric stress. The expansion varies as the square of the electric intensity or voltivity, and inversely as the elasticity.[1]

I have shown, in the *Phys. Rev.* paper above referred to, that the specific inductive capacity of a dielectric is made up of two parts—one due to the matter, and the other due to the ether. When we place a dielectric, therefore, in an electric field, we have a change in the density of the *substance*, and a change in the density of the *ether*.

The former gives us Kerr's phenomenon, the latter changes the weight of the condenser.

This change of weight was referred to in the paper (p. 90), but was derived in developing Fitzerald's vortex theory, from purely dynamical considerations, and its bearing was not then seen.

It was shown by Newton that a change of density in the medium surrounding a particle of matter would account for the gravitational attraction. No theory has, however, been put forward to account for such a change of density, which did not necessitate perpetual loss of energy. I have, however, recently calculated out the value of the electrostatic stress at the surface of a corpuscle, and find it to be of the order 10^{20}; and the elasticity of the ether I have already shown to be a 6.10^{20}. We thus have an enormous stress next the corpuscle, producing a change of density, the amount of the change of density varying inversely with the fourth power of the distance from the centre of the corpuscle, and the total amount of expansion varying inversely as the square. We thus see that the corpuscular charge gives a gravitational effect, and on calculating out the amount for a medium whose elasticity is as I have shown, we find the amount of the change of density is of approximately the same order as that required. We find thus:

1. *Inertia is an electromagnetic induction effect, due to the corpuscular charge.*

2. *Gravitation is a secondary effect, the electrostatic intensity due to the corpuscular charge causing a change of density in the ether surrounding it, this latter giving the gravitational attraction.*

Through the work of Davy, Berzelius, Ostwald, Helmholtz and others, we know that the so-called chemical force is really an electric effect.

I have previously shown that the so-called cohesive force is also an electric effect. (*Elect. World*, Aug. 8 and 22, 1891; *Science*, July 22, 1892, and March 3, 1893.)

Since I have now found that the inertia and gravitational forces are also electric phenomena, it is evident that we are now reduced to deal with but two things, *i. e.*, the electric charge and the ether. The electrician, a modern Aaron, is but new come into the presence of the elder magi, yet his subtle and protean servant has already swallowed theirs. In our text-books we may now logically take as our starting point the four electrical equations.

Gravitation being due to the electrostatic field of the corpuscle (we need a shorter word; electron will hardly do, as it has been used in a different sense—possibly "elat" might do), we might anticipate that gravitational force would travel with the speed of light. This would give rise, as Heaviside has shown, to some second order effects, probably not measurable, so that it is impossible to tell experimentally whether gravitation travels at infinite speed or at that of light. (Heaviside, *Elect. Mag. Theory*, Vol. I, appendix.) But on thinking a little bit, we shall see that if a corpuscular charge were suddenly created, the lines of electrostatic force being normal to its surface, taken as spherical (it makes little difference, the result is the same), that the propagation of such a field has nothing to do with the velocity of light, but has to do, instead, with the velocity of propagation of a *compressional* wave. So that the fact that gravitation is an electric effect does *not* indicate that it travels with the velocity of light.

What is the velocity then? My result is as follows: Since the electrostatic lines forming the field of the suddenly created corpuscular field are radial, no electromagnetic inertia is involved in the creation of such a field; *i. e.*, contrary to what might at first sight be supposed, the rate of propagation of such an electrostatic field in a medium at rest (I will not here take up the question of moving medium, where, under certain conditions, the compression wave should give rise to a light wave) is instantaneous. But may not some new property of the ether be involved? The answer is that it may, but will not change the result. For, from optical phenomena we must have the compressional wave travel either very much faster than light, or very much slower. Now we can easily *prove* that it does not travel slower, by very simple reasoning. Consequently, it travels much faster than light. That is to say,

Gravitational force is propagated at practically infinite velocity as an expansional wave.

Electrical World and Engineer, April 7, 1900.

[1]Compound dielectrics, such as oils containing impurities, such as water or fatty acids, of greater specific inductive capacities, contract under such conditions, but this is caused by lack of homogeneity, *i. e.*, the presence of particles of large specific inductivity, or of ions, and the exception is only apparent. (See *Elect. World*, Jan. 2, 1897.)

The Carpentier Electrical Instruments at the Paris Exposition.

Among the instruments for electrical measurements which are to be seen at the Paris Exposition, there are none ranking higher than those manufactured by J. Carpentier, of Paris. In a prominent position on what might be called the main floor of the Electricity Building in the Champ de Mars this maker has two booths filled with a large collection of laboratory and commercial instruments. One of these is an improved form of slide-wire bridge with a reflecting mirror galvanometer, and two forms of direct-reading ohmmeters are shown, one for laboratory use reading up to 500,000 ohms, and a portable type for measuring insulation resistance, with a range 0 to 50,000 and multipliers of 1, 10 and 100, allowing of measurements up to 5 megohms.

A potentiometer for accurate measurement of voltage, such as required for e. m. f. of standard cells, is shown among other instruments. The method employed is that of putting a known standard voltage in opposition to that to be measured, which is across the terminals of a known resistance. This instrument is capable of measuring voltages down to one ten-thousandth part of a volt, while, by means of multipliers, the readings may be carried as high as 600 volts. A special method is used of calibrating the resistance spools employed for very accurate work, which are provided with an adjustable contact on the inside, which may be regulated by means of a screw. A reflecting galvanometer is used with this instrument. A special design is on view, in which an anti-vibration suspension in oil is used to deaden all motion due to external influences. The good effect of such an arrangement is very apparent here, for the gallery of the Electricity Palace is so far from solid that all the other galvanometers are constantly vibrating; but this one, which is suspended bodily from a bracket by means of wires, shows no trembling in its mirror.

A rotary hysteresis meter of Prof. Blondel is one which is particularly applicable for determining hysteresis losses in iron to be used for dyanmo or motor armatures, inasmuch as it presents the same conditions in the test, making the determination more accurate than when static apparatus is employed. The sample of iron is cut into the form of a small ring and is held in a circular recess above the poles of a powerful horseshoe permanent magnet, which may be

revolved by hand. The ring twists in the direction of rotation of the magnet, carrying a pointer, and being opposed by the torsion of a wire. When the pointer is stationary, a movable scale is turned until the needle coincides with zero, when the direction of rotation of the magnet is reversed, and a scale reading obtained which is proportional to the hysteresis loss. The reading is quite independent of the speed of rotation of the magnet.

The Abraham rheograph, constructed by Carpentier, is extremely interesting. By means of this instrument the actual wave forms of the e. m. f. and current of an alternating circuit are shown on a ground glass screen. The name oscillograph is usually given to this form of instrument, which is essentially a galvanometer having an extremely light moving system placed within a very intense magnetic field. In this case two galvanometers are used, and the curves of current and voltage may be seen at the same time, in phase when a non-inductive resistance is used in the circuit and displaced 90 degs. with the inductive effect.

A form of pyrometer designed by Le Chatelier is exhibited, in which a thermoelectric couple of platinum and platinum-rhodium alloy is used. Heat applied to the junction of these two wires, which project from the end of a long iron tube, produces a current which is passed through a galvanometer graduated to give the temperature directly. A double scale is used, one to read up to 600 degs. Centigrade and one to 1500 degs. A portable mirror galvanometer is also made for use with the pyrometer. The mirror suspension, coil, scale and lamp are all separate, so that the instrument may be packed up for transportation without there being any risk of resulting injury.

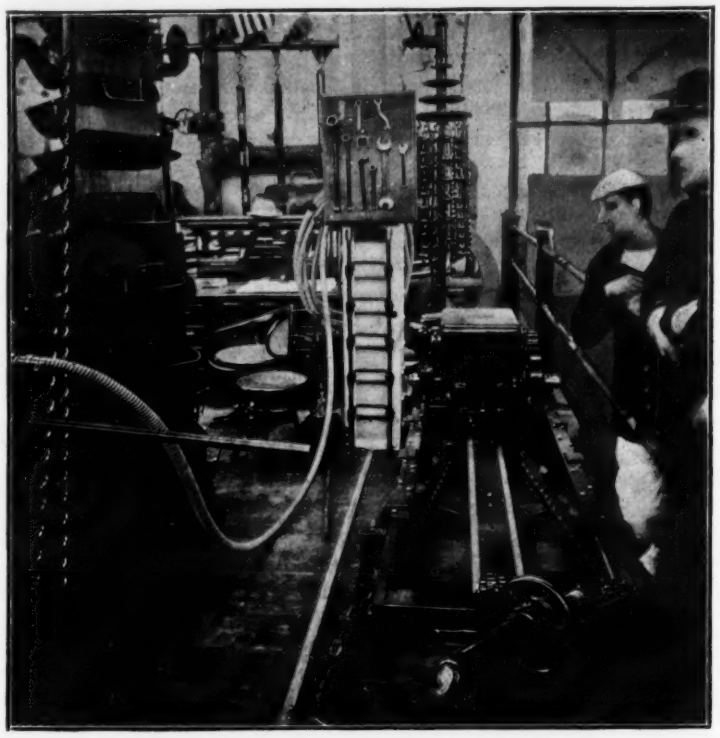
The Baudot telegraph system is shown in this exhibit in working order. The principle employed is the utilization for each sending operator of a certain fraction of sub-divisions of time, so that, for example, six operators may use one line by each taking only, say, one-sixth of a second at one time for a signal. Time is automatically divided among the different instruments, and the period reserved for each is indicated by a click in a telephone receiver close to the operator's ear. It is not, however, necessary that this exact moment should be taken, because, if the transmitting key is depressed too late, the signal is held over and sent automatically at the next time interval allotted to the particular instrument.

Among many other exhibits we may mention the Carpentier model quadrant electrometer, in which the movable system may readily be detached. The disks of the Thomson (Kelvin) type are here replaced by a copper band which rotates close to the inner face of vertical curved plates. On the outside is placed a strong permanent horseshoe magnet acting in the same manner as that of the Weston galvanometer to deaden the swing of the copper band by inducing eddy currents. An interesting exhibit is also a form of Wehnelt interrupter packed with felt to keep in the heat. It has been usual to endeavor to dissipate the heat due to the passage of the current, but the discovery was made that the interrupter may be used on a low voltage after it has heated sufficiently. The start is made on a 110-volt circuit; but after heating up, it is possible to operate with 20 volts.

Standards of various kinds are made by this firm. There are here on view standards of induction of 1-10 henry, 1 henry and 10 henrys; also standard resistances and standard cells. Instruments for commercial use are also shown, such as voltmeters and ammeters of various sizes and designs, for direct and alternating current.

American Electric Mining Apparatus at the Paris Exposition.

The United States exhibit of machinery in the Vincennes Annex of the Exposition is one of the most striking examples of a nation's progress that is to be seen in the whole show, for there are practical illustrations of the working of the most modern machine tools as used in a country where the greatest advance has been made in this line, and where sound ideas and especial ingenuity have combined to produce machinery far superior in design and possible output to that manufactured abroad. The substitution of electric power for hand labor is evidenced in many types of machines, particularly in those cases where the work is heavy, as in mining, where drills and cutters operated electrically effect a large saving of time and money. The Jeffrey Manufacturing Company, of Columbus, Ohio, shows a large variety of mining appliances, among which is an electric chain coal mining machine, designed for use in mines where the cutting is very hard, so that the life of the machine in an average mine is proportionately prolonged and the cost of maintenance decreased. The whole construction of the machine is strong and rigid, without excessive weight. The outside or bed frame is made of steel channel bars with steel braces, and the inner frame, for the cutter chain, has a forged steel centre rail and steel guides. The carriage, containing the main drive shaft and supporting the motor, is of cast steel, as is also the motor field frame. The motor is of solid construction, with iron-clad armature, four-pole field, and two field coils, the whole being enclosed by the frame in such a manner as to be completely protected from injury. It is to be noted that replaceable bronze bushings are used in the bearings instead of babbitt, which is good practice when, as in this case, ample wearing surface is allowed. For low veins of coal a special design of cutting machine has been produced, in which the height over all is only 18 ins. Another specialty of the Jeffrey Manufacturing Company is the electric drill, one of which is set up at Vincennes. The motor is completely enclosed and carries the supports for the drill on its upper side and gears on the back. This compact construction guards the mechanism from damage, for the drill is naturally subject to extremely rough use. For transportation through the mine, the drill and its support, together with a reel of



ELECTRIC CHAIN COAL-CUTTER AT THE PARIS EXPOSITION.

cable and spare drills, may be loaded on a small truck and easily and quickly moved from place to place.

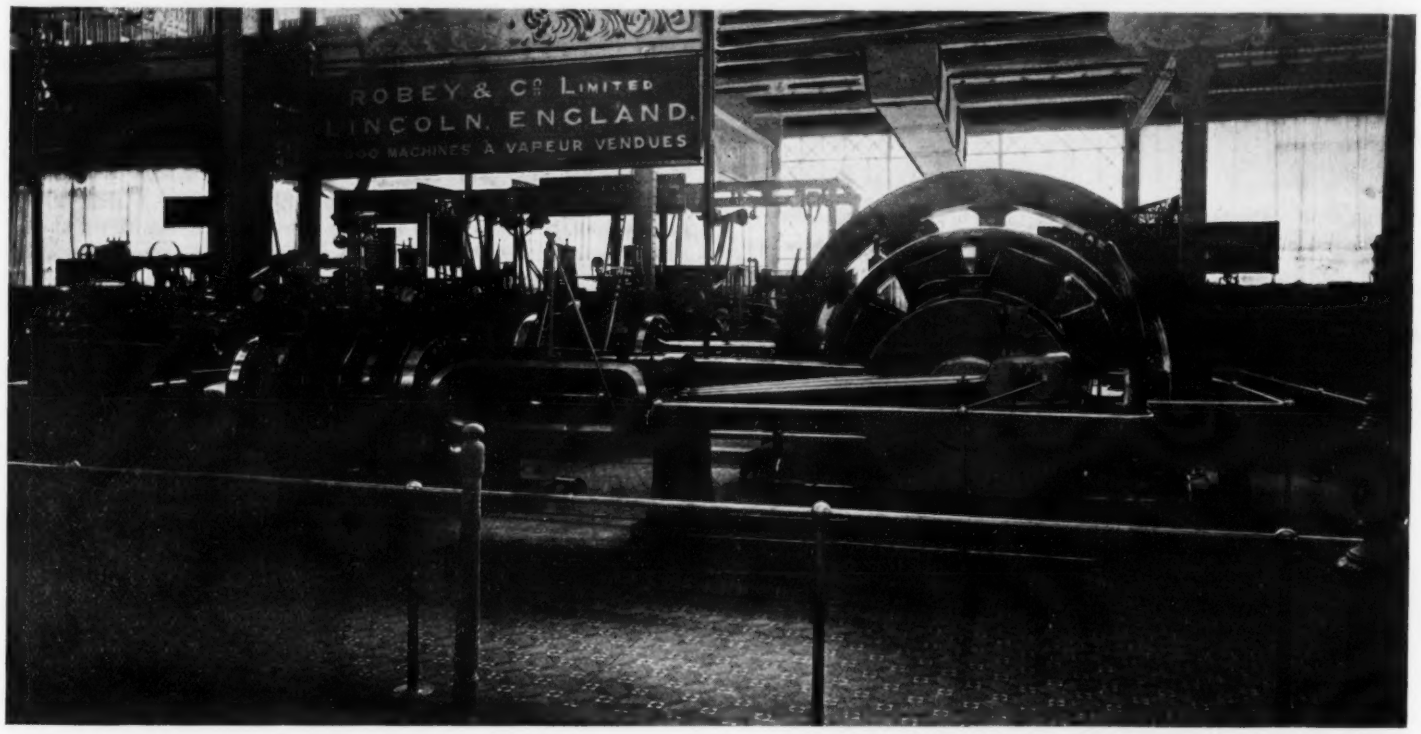
One of the Jeffrey exhibits, for which there was not space at Vincennes, was an electric mine locomotive, so it has been sold to an enterprising restaurant keeper, who uses it to draw customers by giving 2-cent rides on a trailer which is hauled through an artificial tunnel and over mountain scenery on a small scale. The grades are very steep and the curves are sharp, and in the early days of the show the car would leave the track. An engineer who was asked to investigate, found that the rails were on the same level throughout, this construction being adopted because the director of the affair saw no reason why the outer rail should be raised, which he admitted had been provided for originally, according to the plans. A rearrangement of the roadbed has given satisfactory service, and patrons of the house may hear the rumbling of the wheels as the cars swing through the tunnel, and take a ride after dinner as a digestive.

The Jeffrey Manufacturing Company reports that visitors to Vincennes are not very numerous, but there is the consolation, on the other hand, that those who do survive the hardships of the journey to the far eastern end of the city are people who are really interested in the machines there shown. Mr. Sanford Belden, in charge of the company's exhibit, has had many inquiries as to its mining and conveying machinery, and expects that considerable business will be done in Europe as the result of the Exposition.

The Robey Engine Exhibit at Paris.

Messrs. Robey & Co., of Lincoln, England, exhibit at the Paris Exposition a horizontal cross compound engine directly driving a "Tyne" multipolar direct current dynamo. The cylinders of this engine are placed at some distance from each other, sidewise, and the dynamo is placed between them. The cylinder to the right is the high pressure, and the one to the left the low pressure. The high pressure cylinder has a bore of 20 ins. and the low pressure cylinder a bore of 35 ins., the stroke of the pistons being 42 ins. The engine runs at 90 r. p. m. Both cylinders are steam jacketed, and the steam chests are protected and covered by blue steel plates. The high pressure cylinder is provided with a clear way, screw-down stop valves, with arrangement for feeding the jacket.

The high pressure cylinder is fitted with Richardson & Rowland's patent governor and automatic trip valve gear. The valves are circular, double-beat valves of phosphor bronze, arranged to vary the cut-off from zero upwards. These valves are lifted and released by trip levers, actuated by eccentrics, driven from a horizontal shaft. This horizontal shaft rotates at the same speed as the crank shaft, and runs parallel with the engine bedplate. The length of time the levers are in contact is controlled automatically by the governor, and the ratio of expansion is varied to suit the work being done. The exhaust valves of both high and low pressure cylinders are placed underneath, so as to drain efficiently the interior of the cylinders, and to enable the pistons to work safely with the least possible amount of clearance. The low pressure cylinder is fitted with double-beat phosphor bronze valves, driven and arranged in the same way as the valves of the high pressure cylinder.



ROBEY ENGINE AND TYNE DYNAMOS.

The main frames of the engine are heavy cast-iron girder frames, having a massive base under the main bearings. They form bored guides for the piston rod crossheads and the ends project into the cylinders, and form a front cover. The guides and stuffing boxes for the piston rods have been bored out in one operation. Each cylinder is also supported by a heavy casting or foot.

The dynamo has been built by Ernest Scott & Mountain, electrical engineers, Newcastle-on-Tyne, and has been specially designed to work in connection with slow running horizontal or vertical engines. It is of the multipolar radial internally projecting pole type with a slotted drum armature. The generator was built to give the following output:

Total watts	337,200
Amperes	7,440
Volts	230
Approximate r. p. m.	90

The field frame has eight field poles, frame and poles being cast together of cast steel. The exciting coils are wound on gun metal spools, and can easily be removed from the machine when required.

The armature is of the slotted drum type, the core being composed of charcoal iron disks, mounted on a cast-iron centre, to which the commutator is also secured. Armature and commutator are therefore self-contained, and may be removed from the shaft together, without disconnecting any of the armature connections.

It is stated that, owing to the slot-wound construction, this generator is specially suited to transmission of power and traction purposes.

The current is collected by carbon brushes from the commutator, there being eight sets of brushes in all, which are attached to a rocking quadrant with worm gear adjustment. The brush gear, including the frame supporting it, and the worm adjustment gear, are all self-contained and are secured to the bedplates.

"A Practical Telegraph Transmitter Using the Sine Wave for Operating the Wheatstone Receiver."*

The existing transmitter employed with the Wheatstone telegraph system consists of a contact-making apparatus driven by clockwork and controlled by a band of perforated paper, punched out according to the Morse alphabet. The electromotive source is a battery or a direct-current dynamo, and supplies impulses of the "square-topped" or rectangular wave type.

The authors substitute for this transmitter a small alternating-current generator whose shaft is connected with the contact apparatus controlled by a similar but specially punched perforated paper band. At each contact hole in the band a metallic brush resting above the band enters into contact with a metallic drum beneath and sends a sine-wave or alternating-current impulse to line, as distinguished from a rectangular wave.

The salient features of the substitution are, therefore, a greater simplicity in the apparatus and electric source, together with a type of e. m. f. much better suited to long-distance signalling. The clockwork apparatus and battery are dispensed with.

A single positive alternation corresponds to the marking current, and a single negative alternation corresponds to the spacing current. Consequently a positive wave followed immediately by a negative wave, i e., a complete cycle, produces a "dot" in the Wheatstone receiver, while a positive wave followed by two blank intervals and a negative wave, i e., two successive cycles with the interior impulses suppressed, produce a "dash" in the receiver.

*Abstract of a paper by A. C. Crehore and G. O. Squier, read at the International Electrical Congress, Section IV, in Paris, Aug. 23, 1900.

The alternator continually generates alternating impulses, and the holes in the paper band permit these impulses to be sent to line in the proper sequence to produce the dots and dashes required, suppressing the intermediate or spacing intervals. Contact at the brushes

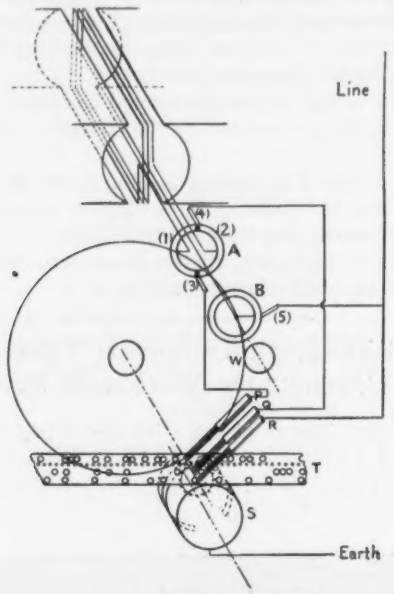


FIG. 1.—DIAGRAM OF CABLE ALTERNATOR AND TRANSMITTER.

is always made and broken approximately at the zero interval between waves, and thus all sparking at the brushes is avoided. The little alternator employed may be of one-quarter horse-power capacity.

In telegraph stations where a number of Wheatstone transmitters are employed simultaneously, there may be but a single alternator

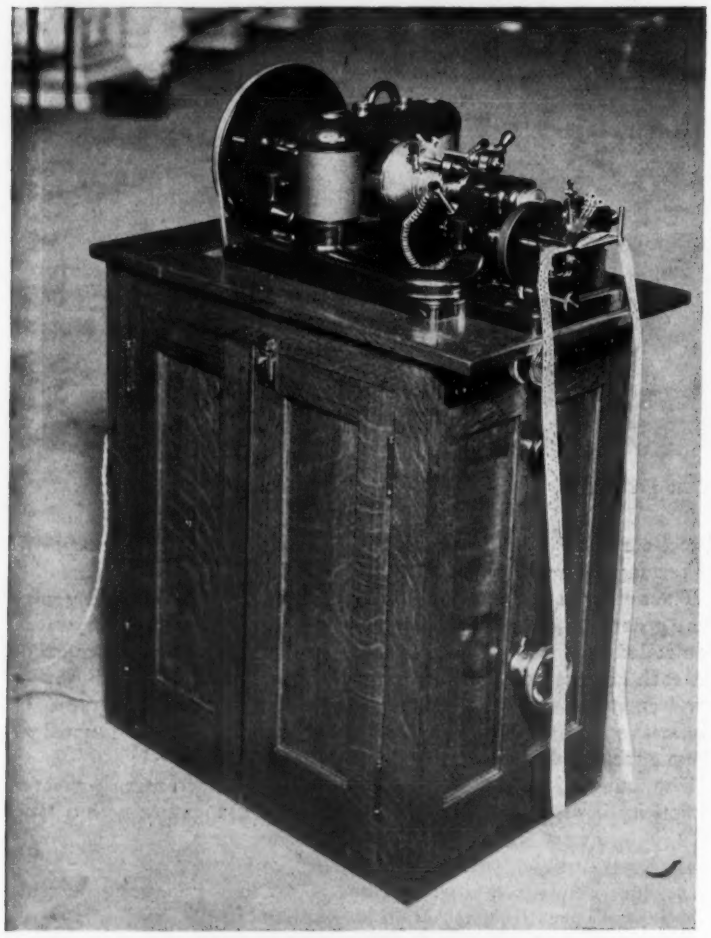


FIG. 2.—SINE WAVE ALTERNATOR.

operated in a separate room, and a separate small synchronous alternating-current motor employed at each desk, the sole duty of which is to drive the paper band under the contact brushes in step with the impulses of the generator. By this means the transmitting apparatus is still further simplified, and the same speed of transmission automatically maintained on a number of independent circuits. The single alternator not only drives the synchronous motors, but also supplies the alternating line currents to the contact brushes.

The advantage of the transmitter is the increase in speed which may be obtained with its aid over long lines. This increase in speed is partly due to the use of a higher voltage in the transmitting source, since voltages of the direct-current type are prohibited above a certain value by the sparking at the contacts, the line currents being interrupted at full strength; whereas the improved transmitter employs alternating currents which are always interrupted at the zero instants, whatever e. m. f. is employed. The increase in speed is also partly due to the sine-wave impulses which travel at a greater effective or apparent velocity over the line than rectangular impulses of equal frequency. The authors claim that the speed of signalling on long lines can be doubled by the use of their transmitter.

A trial was made from London, England, direct through to Aberdeen, Scotland, without repeaters. The limiting speed on this circuit was found to be 107 words per minute with the ordinary Wheatstone transmitter and 195 words per minute with the sine-wave transmitter, employing an e. m. f. of 230 volts only.

Recently sine-wave transmitters have been installed upon the land line of the Commercial Cable Company from New York City direct without repeaters to the Atlantic Cable Landing at Canso, Nova Scotia, a distance of about 1115 miles. The line is of copper, having a mass of about 300 lbs. per mile, with about 18 miles of underground wire. The speed of this through line is greater than the entire carrying capacity of the Atlantic cables of this company.

PARIS EXPOSITION NOTES.

M. PAUL FAURT.—One of the visitors to the ELECTRICAL WORLD AND ENGINEER last week was Mr. Paul Faurt, of Algiers, Africa, whose proposed modification of the Hughes telegraph transmitter was described in our issue of June 30. He is concluding arrangements for practical trials of his keyboard on some of the European telegraph lines.

MR. S. Z. DE FERRANTI, of London, paid a visit to the headquarters of the ELECTRICAL WORLD AND ENGINEER before returning to England. He is occupied with very important central station work, supplying not only the generators and transformers, but also building steam engines which rank with the best turned out in that country, the whole carrying with it a guarantee that is the result of many years of conscientious work, combined with especialy good engineering design.

THE LARGE CRANE by Carl Flohr, of Berlin, which towers above the generating sets in the German section of the foreign power house has had an idle time since the engines and dynamos were finally set up. It is now being used to run back and forth for exhibition purposes, and carries at the end of its chain a large blackboard with the triumphant notice, "Grand Prix, 1900," in gold letters. This is raised and lowered and moved about to the music of the running machinery beneath, while the trumpet of the attendant at the controller is used, perhaps to keep people off the ground tracks on which the crane runs, but possibly also to call attention to the swaying sign with its golden characters.

A SMALL FIRE.—An illustration was afforded the other day of the danger incurred by the careless methods employed in electrical installation work in the Exposition. Small motors of about one-half horsepower are used to drive ventilating fans under the galleries of the engine rooms, and have often given trouble. On the occasion in question the bearings became hot, and, with a loud squeak, the fan stopped. There was a diminutive fuse box in the circuit, but a good-sized copper fuse guaranteed no trouble from frequent renewals. It was not long before the adjacent woodwork was blazing merrily; but, as the accident occurred in the electrical section, the wires were soon cut and the damage confined to the ventilating apparatus. The switch could not be opened, as a special key was needed, which would seem to imply a touching confidence in the good behavior of the motor, on the part of the responsible authorities.

FLOWER FESTIVAL.—On Sept. 6 there was held the first flower festival, on the occasion of a Horticultural Fête. An afternoon procession of floats took place, these representing different fruits and flowers, with young girls in fancy costumes throwing flowers among the spectators. In the evening special illuminations were provided, all the Welsbach lamps along the Champ de Mars being adorned with colored paper shades like parlor lamps, and garlands of flowers and leaves were twined about electric light wires, between which were

connected incandescent lamps. The insulation was afforded by threading the two bare cables through short lengths of twin insulating bushings, these more or less completely covering the wires through the length of the garlands. From the Eiffel Tower cannons were fired and Bengal lights burned, the latter making a pretty effect in the clouds of smoke which swept about the tower, lit by incandescent lamps, as illustrated recently in this journal.

VISITORS at the headquarters of the ELECTRICAL WORLD AND ENGINEER this week include Mr. L. Pilot, who is representing in France Carels Bros., of Ghent, Belgium, builders of the fine tandem compound engine in the foreign power house, which has received a Grand Prix. He is also director of the shops where the Jandus arc lamp is manufactured, in Paris, and reports a good outlook. Mr. R. E. Shawcross, of Manchester, has also paid a visit. He is the engineer for Mather & Platt, of the Salford Iron Works, who exhibit a direct-current 350-kw generator, driven by a vertical cross-compound Galloway engine, this set having received a Grand Prix and gold medal. Messrs. Benj. G. Lamme and W. E. Reed, of the Westinghouse Company, registered at our headquarters, stopping to make a call while on a trip through the Exposition. Mr. and Mrs. A. M. Morrison, of Lamartine, Colo., and Mr. Emile J. Bayle, M. E., of New Orleans, La., have also registered their names as visitors.

AN ELECTRICAL DINNER.—Last week Mr. F. E. Drake, Director of Machinery and Electricity, gave a dinner to the members of his staff at the Automobile Club de France. A very enjoyable evening was spent, the meeting having the air of a family reunion full of happiness and good will. In responding to the toasts proposed, Mr. Drake took occasion to thank his guests for the satisfactory results achieved by the department, and to comment upon the excellent and faithful work done by them which had contributed so largely to the success that had been obtained. Among those present were Messrs. J. S. Anthony, Assistant Director, Department of Machinery and Electricity; W. D. Ball, Engineer of Construction, member of jury; C. T. Malcolmson, Chief Engineer, member of jury; W. R. Talbot, Chief Clerk; C. I. Drake, Trustee Collective Fund; W. E. Weinsheimer, Superintendent Collective Exhibit; E. C. White, Superintendent of Machinery Building at Vincennes; W. M. McKee, Assistant Engineer, Machinery Building; G. H. Patten, Assistant Engineer, U. S. National Pavilion; M. S. Lee, Assisant Engineer, Champ de Mars; E. Rochette, Assistant Engineer, Collective Exhibit.

Two Central Station Wrinkles.

Central station work is constantly presenting new difficulties to overcome and opportunities for introducing some improved or ingenious method of getting at results. For example, we illustrate two recent innovations made by Mr. E. B. Greene, of the Edison Electric Illuminating Company, of Altoona, Pa. Fig. 2 shows the meter-testing outfit used by his men in connection with the Thomson recording wattmeter. The instruments are mounted in the box, which is made about the size of a small dress-suit case. The shunt millivolt and voltmeter, with the two small boxes which make a receptacle for the repair kit and stop-watch and any other small supplies, are on one side of the case. On the other side is a compartment for the cable, cords and bellows; a receptacle for the meter seal and magnet wrench, shown at the bottom; also a separate space for record book and blank paper. This comprises compactly everything in the one case handy for carrying and easy of access.

On looking more closely, a division made of fibre is observed.

FIG. 2.—METER TESTING OUTFIT.

This is hinged and secured down with a brass button, and holds the cable and small tools firmly in place when the box is closed. It furnishes also a desk or plane flat surface for making notes or taking records on while testing. There will also be noticed a little shelf with a brass hook, which is used by the men for hooking onto the base of the meter, and making a very convenient resting place for the tools while a meter is being cleaned and adjusted. This box, when closed and locked, keeps all the instruments, etc., from being handled by any one but the person responsible and holding the key. The bottom, or edge of the box, as it would stand when closed, is fitted with soft rubber feet, which prevent the instruments from getting any unusual or unnecessary jar when the case is set down. This outfit has been in use since January, and is found very satisfactory.

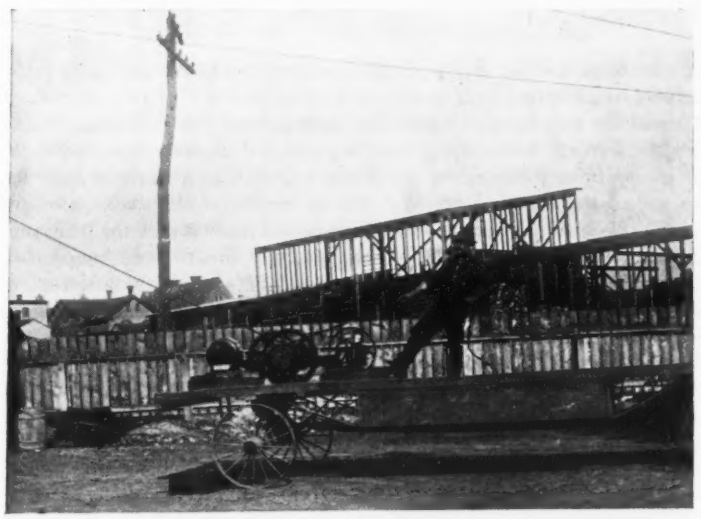


FIG. 1.—STRINGING WIRE BY MOTOR.

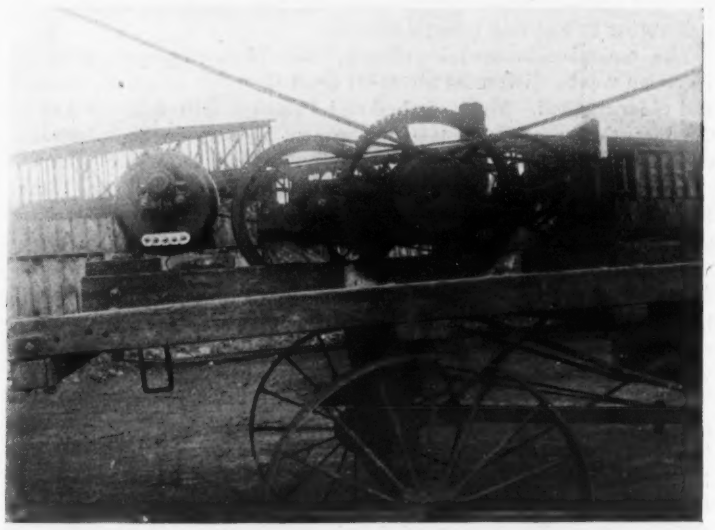


FIG. 3.—WIRE-STRINGING APPARATUS.

Another wrinkle or device of which Mr. Greene is kind enough to supply us with details is a method of stringing wire by motor. It is shown in Figs. 1 and 3. One of the cuts exhibits the motor on the wagon with the winding drum, pulling wire off the reel up to the pole line. Mr. Greene employs a 1-hp G. E. motor, and an ordinary stonemason's crab, with a drum bolted onto the outside large gear

wheel. Speed is reduced by countershaft, which gives a rate of rope travel of about 40 ft. per minute. A three-quarter-inch rope is used and a small, four-jaw, home-made clutch to which the wire is fastened. The wiremen have no difficulty whatever in pulling up 3000 ft. of large size bare copper wire a day on street work, at a very steady and uniform speed; and by putting a brake on the reel the wire is kept taut all the time. Mr. Greene states that they find the plan very satisfactory and much cheaper than horses or any other method with which he is familiar.

Current for the motor is tapped from the company's three-wire system. In running mains to reach a new territory, they deliver the wire at the farthest point on the mains, locating the motor and winding drum at the mains, and then pulling the wire in on the poles. Both Figs. 1 and 3 show the outfit on a construction wagon, which is admirably adapted to pole-line work, as they are enabled to load heavy poles on the wagon very easily. The company has also a derrick, which is mounted on this wagon, for raising poles which cannot conveniently be "piked" in, and where it is compelled to get the work done with a minimum of delay to traffic. This derrick is 20 ft. high and permits the picking up of a 40-foot pole and raising it in five minutes with a very small crew of men.

Wireless Telephony.*

BY SIR WILLIAM HENRY PREECE, K.C.B.

The first experiments in this direction were made in the month of February, 1894, across Loch Ness, in the Highlands. On that occasion trials were made to determine the laws governing the transmission of Morse signals by my electromagnetic method of wireless telegraphy, which has formed the subject of frequent reports to this section since 1884. Two parallel wires well earthed were taken, one on each side of the lake, and arrangements were made by means of which the wires could be systematically shortened, with a view of ascertaining the minimum length necessary to record satisfactory signals. It occurred to Mr. Gavey, who was experimenting, to compare telephonic with telegraphic signals, i. e., to ascertain whether articulate speech could be maintained under the same conditions as Morse signaling. The trials showed that it was then possible to exchange speech across the Loch at an average distance of 1⅓ miles between the parallel wires, when the length of the wires themselves was reduced to 4 miles on each side of the water.

What led to this train of thought was the fact that, although the volume of a telegraphic current was immensely greater than that of a telephonic current, whenever through want of balance in a loop disturbance was evident, then telephonic cross-talk was also manifest. In other words, a weak telephonic current was apparently as powerful a disturber as a strong telegraphic one.

The sensation created in 1897 by Mr. Marconi's application of Hertzian waves, distracted attention from the more practical, simpler and older method. Mr. Evershed and Principal Oliver Lodge had in the meantime much advanced the system by introducing admirable call systems.

In 1899, I conducted some careful experiments on the Menai Straits, which determined the fact that the maximum effects are produced when the parallel wires are terminated by earth plates in the sea itself. It became quite evident that the ordinary inductive effects are much enhanced by conductive effects through the water and that in consequence shorter wires are practical. No special apparatus seems necessary. The ordinary telephonic transmitters and receivers were used.

It became desirable to establish communication between the islands, or rocks known as the Skerries, and the mainland of Anglesey, and it was determined to do this by means of wireless telephony. The lighthouse at the Skerries was wanted to be in communication with the coast-guard station at Cemlyn, which is connected with the Post Office system. The bottom of the channel is too rough and the current too violent for a cable. A wire 750 yards in length was therefore erected along the Skerries, and on the mainland one of 3½ miles from a point opposite the Skerries to Cemlyn. Each line terminates by an earth plate in the sea. The average distance between the parallel portions of the two wires is 2.8 miles. Telephonic communication is readily maintained and the service is a good one. Lodge's call system will be used.

Further experiments with wireless telephony have recently been made between Rathlin Island, on the north coast of Ireland, and the mainland. The east and west portion of the island of Rathlin is about 8 miles from the mainland, but a tongue of land projects southward to within a distance of 4 miles. Communication was required between the lighthouse near the northeastern corner of the island and the mainland, and the question for solution was whether an overhead line running the whole length of the island from east to west was necessary to obtain good communication, or whether a shorter line across the neck of the southern peninsula would serve. The preliminary experiments that have been made proved conclusively that communication, both telegraphic and telephonic, has been readily maintained by means of temporary wires established across the neck of the peninsula along the shorter line. Wireless telephony across the sea is now a practical and commercial system.

No experiments have yet been made with ships, but it would appear simple to speak by telephone between ship and ship, or between ship and shore, to considerable distances across space by means of a circuit formed of copper wire terminating at each end of the ship in the sea, passing over the topmast and using simple telephones.

*Abstract of paper read at the British Association meeting, Bradford.

Elements of Illumination—XI.

BY DR. LOUIS BELL.

CERTAIN classes of interiors require, on account of the uses to which they are put, especial adaptations of the radiants either in kind, amount or position. One of the commonest demands is for an illumination of unusual brilliancy and steadiness in such places as reading rooms, draughting rooms, schools, weave shops and such like places where the eyes are under steady if not severe strain. Ordinary good reading illumination, such as we have been considering, must be strengthened to meet the requirements. Simple increase in the number or power of the radiants sometimes meets the conditions, if

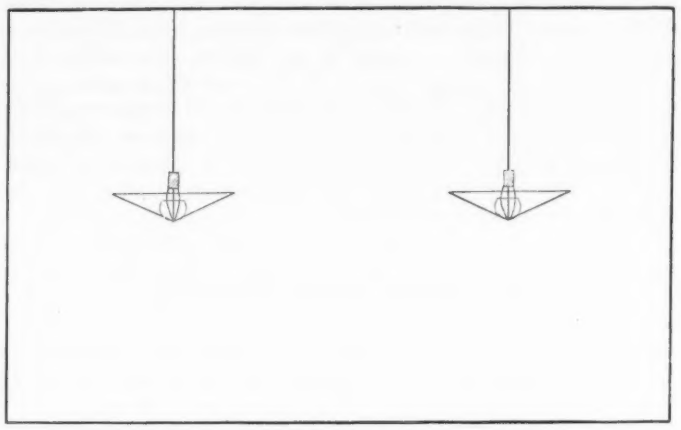


FIG. 1.—INVERTED ARC LIGHTS AND REFLECTOR.

such increase can be had without thrusting too powerful lights into the field of vision.

It may be necessary to furnish 1 candle-power for each 2 sq. ft. of area, or, in extreme cases, 1 candle-power per square foot. One of the most useful schemes for supplying such large amounts of light is the use of the inverted arc in connection with a very light interior finish. The ordinary continuous-current arc in virtue of the brilliant crater of the positive carbon throws its light downward; but if the current be reversed so as to form the bright crater on the lower carbon most of the light is thrown upward toward the ceiling, and is there diffused. If, as usual, these arcs are arranged with inverted conical reflectors of enameled tin or the like, all the direct rays are cut off and the entire illumination is by diffused rays. The result is a very soft and uniform light, white in color, and of any required brilliancy. Fig. 1 shows in diagram the principle of this device. In case a white ceiling is not available, large, white diffusing screens over the lamps, of enameled tin or even of tightly stretched white cloth or paper answer the purpose. Indeed, this was the original form of the device as shown by Jaspar at the Paris Exposition of 1881.

With reference to Fig. 1, it is sufficient to note that the conical reflector should be rather shallow, just deep enough to throw the light wholly on the ceiling and upper walls, but shallow enough so that two neighboring lights shall, as shown, distribute light over each other's fields, which improves the average steadiness of the illumination. The arcs need no diffusing globes, a clear globe being sufficient, and open arcs may be freely used, to the material improvement of the luminous efficiency, never very high in this form of lighting. The

heights of the arcs should depend somewhat on circumstances as to the appearance and the purpose of the lights, but will generally be half to three-fourths the height of the room. The reflectors may be from 3 ft. to 6 ft. in diameter, and may have an angle at the apex of 120 degs. to 140 degs. Only in case of having to throw the light on special screens rather than on the natural ceiling should the reflectors have less aperture than just indicated. They then become of the nature of projectors and the angle at the apex may be 90 degs. or so.

As to the efficiency of such illumination one may roughly assume 1 watt per spherical candle-power for open continuous-current arcs, and may reckon on a loss of about one-third in the process of diffuse reflection. The diffuse illumination may then be taken as being in candle-power about two-thirds the number of watts expended, not including artificial resistances. Thus, a continuous-current arc, taking 9 amperes to 10 amperes at about 50 volts, utilized in this manner will illuminate 300 sq. ft. to 400 sq. ft. on the basis of 1 sq. ft. per candle-power, or 600 sq. ft. to 800 sq. ft. at 2 sq. ft. per candle-power. It must be noted that if enclosed arcs are used in this way, materially less light is obtained, as is well known. Even with both outer and inner globes clear one cannot count on much better than 2 watts per mean spherical candle-power, although occasional results of 1.5 watts or a little below are attained. Alternating lamps require, of course, still more energy, and with enclosed arcs in general one would hardly find it advisable to allow, when using ceiling diffusion, more than half to three-fifths of the area per watt just indicated for open arcs.

These figures are necessarily only approximate, but while enclosed arcs have some conspicuous virtues, high efficiency as respects mean spherical candle-power is not one of them. In all this lighting by diffusion the diffusing surfaces *must* be kept clean, else there will be loss of light. Under even the best conditions one does not do very much better than 2 watts per candle-power, and lack of care or bad engineering may easily transform this into 3 or 4 watts per candle-power, which is no better efficiency than incandescents would give.

The chief advantage of this diffused lighting is that it enables one to secure very brilliant illumination with white light, without trying the eyes with intense radiants.

This illumination has, however, one curious failing in that as ordinarily installed it is *shadowless* and the light has no determinate direction. For certain kinds of work this is a very trying peculiarity, severely felt by the eyes. It may be remedied in various ways, of which perhaps the simplest is the lateral displacement of the lamps shown in Fig. 2.

This gives a predominant direction to the light, something akin to the effect produced by a row of windows along the side of the room, and is probably as near an approach to artificial daylight as can be attained by simple means. It is not unlike in principle the "artificial moon" used in the reading room at Columbia University, consisting of a great white ball intensely illuminated by arcs backed by projectors.

In using the arrangement of Fig. 2, about the same relative number of arcs is required as in Fig. 1, but they are placed in one row instead of two. The unilateral effect could be greatly enhanced by a diffusive screen *a b*, Fig. 2, running along back of the arcs. Its angle with the ceiling evidently depends on the shape of the room.

Unilateral illumination is often desirable from a hygienic standpoint, whether diffused or not. In many cases well-shaded arcs may replace the diffused lighting just described, though it is generally rather less steady. But it must be remembered that an arc having both inner and outer globes opalescent is scarcely, if at all, more efficient than incandescent lamps, assuming both to be worked off constant potential mains; hence, unless the whiteness of the arc light is essential, incandescents, being steadier, are very often preferable.

In factories where colored fabrics are woven, and shops where they are sold, white illumination is a matter of great importance, and arcs are especially useful. In the mills the necessary illumination depends largely on the color of the fabrics. It should, as a matter of experience, range from 2 sq. ft. per candle-power to 1 sq. ft. per candle-power in passing from white to dark and fine goods. The candle-power noted here is *actually* mean spherical, or hemispherical if reflectors are used, taken from the real performance of the arc well shaded. This qualification means practically 300 sq. ft. to 400 sq. ft. for each arc of 450 watts to 500 watts in the extreme case, and 600 sq. ft. to 800 sq. ft. for white and light-colored goods. Shops where such goods must be sold by artificial light should be lighted on very nearly the same basis. For brilliant illumination, where color distinctions must be accurately preserved, the arc at the present time stands quite alone, and should always be used.

Where arc lights are not available and it is desired to furnish approximately white light, there is extreme difficulty in meeting the requirement. Mantle gas burners with extreme care in selecting tinted shades to correct the generally greenish cast of the light may be made to give fair results, but are considerably inferior to arc lights. Incandescent lamps fail to meet the requirement, and perhaps the closest approximation in the matter of color to the arc is to be found in the acetylene flame. However, all these substitutes are but making the best of a bad job.

In the lighting of workshops for various purposes no such brilliant illumination as has been mentioned with reference to textile factories is required. The most economical scheme of illumination is to furnish general illumination in moderate amount, and to reinforce it in points where brilliant light is needed by extra lights at these places. So far as the general illumination is considered, 1 candle-power to about 4 sq. ft. or 5 sq. ft. is ample. The extra lights should be put as directly as possible bearing on the work in hand, and furnish illumination at that work to the extent of from 1 cu. ft. to 2 cu. ft. or 3 cu. ft., according to the need of the work.

It should not be forgotten that good illumination in a workshop tends materially to increase the quantity and improve the quality of the work turned out.

In most instances the color of the light within the range of ordinary illuminants is not a matter of considerable importance, but the light must always be reasonably steady. Hence the incandescent lamp and the mantle burner for gas are by far the most valuable sources of light generally to be found. Ordinary bat-wing gas burners are probably the worst in point of steadiness, although a badly adjusted electric arc is a close second. Where very powerful radiants are desired, the large regenerative gas burners give a very brilliant and steady light. They throw out, however, a great deal of heat, which is sometimes objectionable, and are less economical of gas

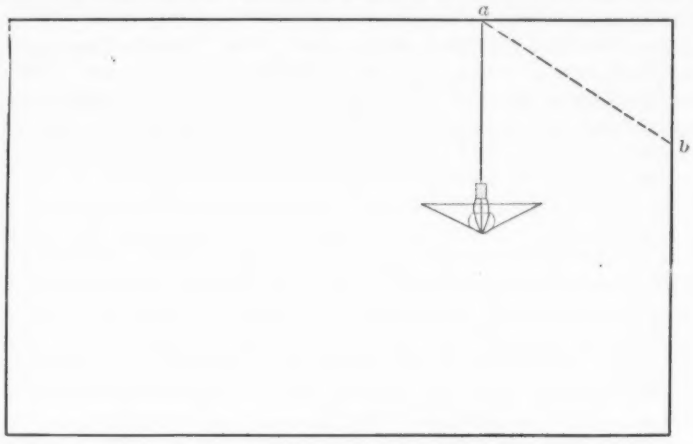


FIG. 2.—INVERTED ARC LIGHT.

than the mantle burner. If the Nernst incandescent lamp is brought, as it promises to be, into commercial shape, it will prove exceedingly valuable for the illumination of large enclosed spaces, by reason of its considerable power and the whiteness and steadiness of its light. At the present time it is not far enough past the experimental stage to be a serious competitor of other illuminants.

A very special branch of illumination is the lighting of immense enclosed spaces, such as are found in exposition buildings. This work is on such a large scale that it almost partakes of the nature of outdoor lighting, with which it is very intimately connected as a practical problem. The amount of light required in single enclosed spaces of colossal dimensions like exposition halls varies considerably according to the practical use to which the space is to be put. As a rule, the best lighting effects in these large spaces are secured by the use of arc lights to the exclusion of other illuminants. In a building covering one or several acres, and perhaps between 100 ft. and 200 ft. apart, incandescents of ordinary powers look lost; and if the roof does not fade away in darkness a very large number of lights must be required to bring it into prominence, placed so high from the floor as to be of little service for the general illumination. Moreover, such buildings have generally a very large amount of glazed side and roof space, furnishing the ordinary daylight illumination. Consequently the walls and ceiling diffuse very little light. With arc lights the power of the individual radiants bears some respectable proportion to the size of the space to be illuminated. The luminous efficiency is increased, and by sufficient massing of lights with reflectors, even the

highest halls can be beautifully lighted. The amount of light required per square foot of floor space is very considerable owing to the height and power-diffusing properties of the building, and for the best results 1 candle-power actual should be furnished for each 2 sq. ft. to 4 sq. ft., according to conditions.

Incandescent lamps have a high decorative value in connection with such work, but to be used effectively must be massed somewhere near the plane of illumination, lights in and about the roof being practically only for decorative purposes.

The subject of exposition illumination is so large and special in its character as to be hardly appropriate to the scope of the present paper.

Systems and Apparatus for Light and Power Distribution—I.*

BY C. P. STEINMETZ.

IT is with some hesitation that I undertake to speak on the problem of power distribution for lighting before an assembly of men who have made the solution of this problem their life work, but while I cannot expect to offer much that is new, I shall endeavor to consider the problem from a somewhat different point of view. Having designed very many machines and apparatus of all kinds, watched their operations personally or with the eyes of others, and studied their nature theoretically and experimentally, I shall try to discuss in the following the nature and behavior of those apparatus which are of interest to you.

As you know, there is a considerable difference between satisfactory operation and unsatisfactory operation. A machine may be satisfactory, that is, it fulfills all the guarantees asked by the customer and given by the manufacturer, and when properly handled and taken care of, under reasonably fair conditions, it does its work and does it well. But the more you become familiar with it, the less you are confident that you can rely upon it in any emergency, and that it will not go back on you just when you need it most. That is the feeling experience has given me regarding 60-cycle converters, for instance. Other machines again, the longer you operate them the more confident you become that you can rely on them under any conditions, normal or abnormal. This different behavior is inherent in the type of apparatus, equally good design and construction presupposed.

I shall not reopen the question of alternating or continuous current distribution, since for your class of work experience has pretty well decided in favor of continuous current for most cases, and relegated alternating current to pioneer work in outlying districts. The usual system of light and power distribution in larger cities is the continuous current Edison three-wire system, supplied from a number of stations located in the centres of distribution, and operating direct connected units, or pairs of 125-volt face commutator machines. This type of machine has the advantage of being more economical in space than any other type, and thus is specially suited for this class of work, where 125-volt machines are used; when using 250-volt machines, the carbon brush separate commutator type is generally employed.

Series arc lighting is done by belt-driven arc machines; outlying districts are supplied with alternating current by belted or occasionally direct connected alternators. In these stations the storage battery has been successfully introduced. It increases the station capacity by supplying power during the peak of the load, increases the economy by permitting to shut down smaller stations during times of light load, increases the distance feasible for power supply, and permits an almost unlimited supply of current for a short time. In this class of service, where abuse of the battery can be avoided, its depreciation is moderate, and its low efficiency, which probably does not exceed 70 to 80 per cent, is no serious objection, since the battery receives power when there is a surplus and returns it when power is most valuable. The lesser economy of operating a number of smaller stations in unfavorable locations led to the desire of generating the power in one large station in favorable location outside of the city, by steam or water power, and distributing it to the sub-stations. The power is generated in one station by a number of large direct connected three-phase alternators, transmitted at high voltage to substations, and there transformed or converted into the different forms of power required, low voltage, continuous current for the main distribution, alternating for outlying districts and pioneer work, and constant current for arc lighting.

*Paper read at the 21st convention of the Association of Edison Illuminating Companies, Saratoga, N. Y., Sept. 4, 1900.

The first and most important question to be considered is that of frequency. Incandescent lighting is feasible at 30, and satisfactory at 40 cycles. Arc lighting is feasible at 40, and satisfactory at 60 cycles, but still better at 125 cycles. Rotary converters are feasible at 60 cycles, but perfectly satisfactory only at 25 cycles. In direct connected slow-speed alternators the lowest frequency is the most desirable. Where a continuous current network is an important part of the system, and even where only a noticeable part of the power is to be transformed to continuous current, the rotary converter is the most efficient and reliable apparatus for use. A number of converters are in satisfactory operation at 60 and even 66 cycles, under favorable conditions as regards steadiness of power supply, low resistance of transmission line, careful attendance of commutator and brushes, etc. The converter, however, is essentially a commutating machine like the continuous current generator, differing therefrom only in so far that it must run in synchronism with the alternating supply current.

The most essential part of the commutating machine, and that which under unfavorable conditions of operation or design is most troublesome, is the commutator. It is obvious that, the lower the peripheral speed of the commutator, the lower the volts per commutator bar, and the wider the commutator bars, the better is the commutator. Assume thus as conservative values a width of bars of ⅜-in., a peripheral speed of 3000 ft. per minute, and 8 to 10 volts per segment, values which, while higher than customary in the continuous current generators with which you are familiar, are still within good and conservative practice under the favorable conditions existing in the converter (absence of armature reaction and high number of revolutions). At 250 to 300 volts, 8 to 10 volts per bar give 30 bars from brush to brush, and ⅜-in. width of bar then give a commutator pitch of 30-in. x ⅜-in. = 11¼ ins., which is to be passed over during each half-wave of the alternating current. At 3000 ft. per minute this gives

$$\frac{3000 \times 12}{11\frac{1}{4} \times 60} = 53.3$$

half-waves, or about 27 cycles per second as the upper limit of conservative converter design. For comparison it may be stated that the frequency of large, low-speed, direct connected continuous current generators averages 8 to 12 cycles, and about twice this value in high-speed machines. At 60 cycles, where the commutator has to move the distance from brush to brush in 1-120 of a second, conservative design of the commutator is not possible any more, and such machines thus are satisfactory only under favorable conditions of operation, although it must be conceded that the voltage of 250 is relatively the best suited for 60-cycle converters.

The converter necessarily is a multipolar machine, and the number of poles must be the larger, the higher the frequency. This requires that the armature reaction of the machine, considered as continuous current generator, must be high, to avoid cross currents between the poles and unequal current distribution between the different sets of brushes of equal polarity, and consequent heating and sparking. Due to the unavoidable inequalities of the different poles the voltages induced thereby are more or less different, and this difference has to be compensated by the magnetizing effect of the armature reaction. For instance, in the face commutator machines, with which you are familiar, you will find, by disconnecting the brushes from each other, differences of voltage between different poles amounting in extreme cases to 10 per cent or more. With the very high armature reaction of these machines a very slight difference of current takes care of this inequality, but with a machine of very low armature reaction, as the 60-cycle converter (in which the space per pole on the armature surface is limited by the frequency) unequal current distribution may become serious. This feature is the cause why in double current generators close regulation is not permissible by good design. The higher the frequency the greater must necessarily be the peripheral speed of the armature of the converter, and the greater thus its momentum. High momentum, however, predisposes to hunting directly as well (the momentum entering as terms in the equations of hunting) as indirectly, by making the machine less able to follow slight pulsations of frequency as due to the pulsation of the engine speed. For these reasons it is very undesirable to choose a higher frequency than 25 cycles for converter work, and where the continuous current service is a very small part of the total load only, and thus 60 cycles is chosen to accommodate the alternating load, it is preferable rather to use motor generators entirely or partly for the continuous current supply.

To understand the phenomenon of hunting, let us take the simplest case—a generator of absolutely steady and constant e. m. f. feeding a

converter or synchronous motor over a circuit of certain resistance and self-induction or reactance, with a constant load on the converter. The usual theory of the textbooks then shows that the counter e. m. f. of the converter adjusts itself to a definite phase relation with regard to the generator e. m. f., depending upon the load and the excitation.*

Closer investigation shows, however, that the phase of the counter e. m. f. of the converter, and thus its speed, and in consequence thereof the current, can pulsate around a mean position, and the power supplied by the generator pulsates correspondingly, with a period depending upon the e. m. fs., the impedance, the momentum of the moving masses, and several other constants, but usually of a magnitude of somewhere near one cycle per second. During the time of acceleration the generator supplies an excess of power, which is stored by the moving masses, and returned during retardation, where the generator supplies less power than the load on the converter represents. This period is entirely definite and independent of wave-shape or engine pulsation, although the latter may start the oscillation. Obviously, 25-cycle converters with their higher armature reaction are preferable in this respect also.

Since several of the constants entering the equations of hunting are beyond the control of the designer as well as the user, the tendency to hunting cannot always be avoided, but the hunting can be suppressed by damping devices, where the conditions are made favorable therefor. The most efficient damping device is copper bridges between the pole pieces. During the oscillation the alternating power supplied, and thus its armature reaction in the converter, pulsates, and since the mean value of alternating and continuous current armature reaction neutralize each other, an oscillating armature reaction remains (which during excessive hunting causes the vicious periodic sparking, by producing an active magnetic field at the brushes). By intercepting this oscillating magnetic field by the low resistance closed circuits of the copper bridges between the field poles, the currents induced therein exert a damping action and thus suppress the oscillation.

As compromise frequency 40 cycles has been proposed, and has in some instances been used to advantage. As a rule, however, a compromise frequency is undesirable for your class of work as being not best suited to any application. For small transformers and for arc lighting, especially indoor lighting, 40 cycles is rather below best practice, while for converters and slow-speed generators it is inferior to 25 cycles, although better than 60 cycles.

The proper field of application of 40 cycles is power and light distribution for mills, factories, etc., with numerous small and moderate size motors, especially of the induction type, and incidental incandescent and arc lighting, either directly from low-voltage slow-speed alternators or by a small number of large step-down transformers. For very long transmission lines of very high voltage under circumstances excluding 25 cycles, 40 cycles is also to be recommended.

In the generating station the number of poles of the generator obviously is directly proportional to the frequency. At 75 revolutions a 25-cycle generator requires 40 poles, and a 60-cycle generator 96 poles. The smaller the number of poles, however, with the same engine, the steadier is the frequency. In the steam engine, with the steam impulses the speed periodically rises and falls. Assuming, for instance, in a cross-compound engine with four impulses per revolution, that the engine speed rises 1-10 per cent during the impulses and drops behind as much between the impulses. For each impulse the armature moves, in a 40-polar 25-cycle alternator, over 10 poles, and thus dropping behind 1-10 per cent amounts to 1-10 per cent of 10 poles, or 1-100 of the pitch of one pole. Since each pole gives one-half wave of alternating current, or 180 degs. of phase, 1-100 pole amounts to a dropping behind of the alternator wave by 1.8 degs.; and if at the same moment another alternator connected in parallel is ahead by the same amount, the e. m. fs. of the two machines are out of phase with each other by 3.6 degs., and a cross current flows between them, which equals sin 3.6, or 6 per cent of the short-circuit current. With a 96-polar 60-cycle alternator moving over 24 poles per impulse, the phase displacement will be 8.6 degs., giving a cross current equal to 14.4 per cent of the short-circuit current. It immediately follows that the larger the short-circuit current, that is the closer the regulation of the machine, the greater must be the cross current. Thus too close regulation in undesirable, and with such large units unnecessary also. As a rule, the lowest regulation permissible by the nature of the load gives the most reliable and best operating machine.

Experience has shown that a deviation from uniformity of the frequency by 2.5 to 3 degs. in phase (that is, a maximum phase displacement between two alternators of 5 to 6 degs.), constitutes about the upper limit of good practice. This is obviously much more difficult to secure with high than with low number of poles. It should preferably be secured by the design of the engine, that is by balancing the momentum of the reciprocating masses against the steam impulses, and not by very large fly-wheel capacity, since large fly-wheel capacity rather predisposes to hunting. With multiple expansion engines, however, especially of the vertical type, the speed variation due to the finite length of the crank shaft is frequently more serious than that due to the steam impulses. While the former is less in magnitude, it extends over a greater period, one-half a revolution, so that the phase displacement caused thereby is larger. Essential, however, is that the uniformity of rotation of the engine unit is maintained also when operating in parallel with another unit. The steam engine governor inherently tends to hunting. That is, if the engine speed is slightly low, the governor opens and admits more steam, sufficient not only to carry the load at the normal speed, but also to accelerate it, and not only this, but it keeps opening until the speed has recovered. That means when the speed has become normal, more steam is admitted than required, and the engine continues to accelerate until the governor begins to close, and now over-reaches in the same manner in closing. Obviously the higher the fly-wheel capacity, the slower is the engine to recover its speed, and the greater the over-reaching. Where one engine only is operated, the governor usually comes to rest soon. When running in parallel with another machine, however, the governor of the second engine may take up the oscillation, thus causing a hunting between the governors.

The remedy necessarily must be looked for in the design of the engines and their governors. While the uniformity of speed during the rotation should be as great as possible, a close speed regulation from no load to full load is not necessary nor desirable with large units, but it is rather preferable that the speed from no load to full load should drop several per cent to insure good division of load between the machines, operated in parallel. Where the main station is near the centre of distribution and continuous current supplied therefrom, either a converter sub-station may be located in the main generating station, or all or a number of the generators built as double current machines, that is machines producing alternating as well as continuous current. Double current generators are limited to those sizes and speeds and number of poles, where simultaneously a good alternating and a good continuous current generator can be designed. Thus in most cases they are not feasible for anything above 25 cycles. They require step-up transformers. As a rule, if not a very large part of the power is used immediately as continuous current, ordinary alternators are preferable. The double current generator is specially suited in a system of supply from a number of continuous current stations, of which one predominates in size and economy of operation. By thus installing double current generators in this station, they can be used during the peak of the load to supply continuous current, while during light load the smaller stations may be altogether shut down and power supplied to them from the double current generators, thereby maintaining more constant load on the main station. In such cases inverted converters can be used also, to change the continuous current power to alternating for transmission. When operating rotary converters inverted, that is, changing from continuous to alternating current, precautions have to be taken to keep them from racing. In the inverted converter, as in the continuous current motor, the speed depends upon the field strength. Lagging current, however, demagnetizes the field, and thus, if in an inverted converter the current begins to lag (as for instance by starting a converter from it), its speed increases, and may increase so rapidly that it cannot be controlled by the field rheostat. Obviously when running in multiple with alternating current generators, this danger does not exist, but the inverted converter speed is held by the generator, provided the latter is large enough not to be accelerated by the inverted converter.

While similar to the converters in their appearance, the double current generators differ essentially therefrom in their internal constants. In the double current generator alternating and continuous current flow in the same direction and the armature reaction and consequent field distortion are due to the sum of the two currents. Thus the cross section of the armature conductor must be large and the armature reaction moderate.

*Such a phase relation, that in the polar diagram the generator e. m. f., the converter e. m. f. and the e. m. f. consumed by the current in the line impedance from a triangle, and the product of the current and the projection of the e. m. f. upon the current equals the load.

Annual Meeting of the New York State Street Railway Association.

The eighteenth annual meeting of the Street Railway Association of the State of New York was held at Buffalo on Tuesday and Wednesday, Sept. 18 and 19, with a large attendance. When the association was called to order by President Rogers at the Iroquois Hotel Tuesday morning over 100 delegates responded to the roll-call. Mayor Diehl welcomed the members of the association to Buffalo, after which President Rogers responded. His annual address was, as usual, an able and comprehensive survey of the field. As to the Ford franchise law, he said that its result was yet to be ascertained. "In my opinion there is but one result, and that is disappointment for the makers of the law, and the people, and dissatisfaction to the corporations which it affects. I would again call your attention to the injustice and unfairness of the law passed three years ago, taxing street surface railways 1 per cent on gross earnings, while other corporations (who are better able to pay the tax) are taxed one-half of 1 per cent. Nearly every legislator who has been consulted on the unfairness of this act admits that section 185 of the general tax law should be amended, thus leaving railway companies in the same situation as other public service corporations. It is our duty earnestly to take the matter up with the Legislature, and I believe that this serious injustice can be rectified. Foreign street railways seem to be more fortunate than those of the United States in the matter of tax upon gross earnings. As an illustration—the British tramways are paying into the public treasury less than $600,000 annually in a formal tax on gross receipts of $25,000,000. The street railways of New York and Massachusetts alone are paying nearly $2,500,000 on gross receipts of $50,000,000."

Papers were then read on "Accidents on Street Railways; Methods Employed in Handling Same and Preparing for Trial," by D. W. Patterson, of the legal department, Metropolitan Street Railway Company, New York; "How Can We Increase the Efficiency of Our Employees?" by E. G. Connette, vice-president and general manager of the Syracuse Rapid Transit Railway Company, of Syracuse; "Railway Power Transmission," by J. H. Armstrong, of the General Electric Company, Schenectady, and "The Use of Storage Batteries on Small Roads," by B. B. Nostrand, Jr., president of the Peekskill Electric Light and Power Company, of Peekskill.

At the afternoon meeting papers were presented by A. S. Mann on "Precision in Steam Power Making;" by C. F. Ubelacker on "Practical Experience in the Operation of Combined Public Franchises by One Company;" by H. D. Cooke on "Compressed Air Motors;" by T. Henning on "The Storage Battery—Its Use in Railway Plants;" by Prof. H. H. Norris on "Storage Batteries in Railway Power Stations;" by T. J. Nicoll on the "Rochester and Sodus Bay Railroad," and by R. E. Danforth on "Rotary Transformer Stations" and "Snow and Snow Plows."

After the close of the Tuesday afternoon session the delegates were taken to the Cold Spring power house of the Buffalo Railway Company. After thoroughly inspecting this plant they visited the Pan-American Exposition grounds at the special invitation of Director-General Buchanan. Much interest was expressed in the buildings for this important fair, which have now advanced quite far, and at the extent of the proposed exposition.

The annual banquet was held Tuesday evening at the Ellicott Club. There was an attendance of about 200. Mr. Rogers presided and Mr. Ely, president of the International Traction Company, was toastmaster. The gentlemen who occupied seats at the principal table were the Hon. W. Caryl Ely, H. H. Vreeland, the Hon. S. Fred Nixon, M. Nussbaum, P. F. Trainer, H. H. Littell, Alexander J. Porter, T. F. Thomson, the Hon. William I. Buchanan, W. B. Rankine, Herbert P. Bissell, the Hon. John G. Milburn, Charles J. Bissell, Henry A. Robinson, Burt Van Horne, Tracy Rogers, the Hon. Conrad Diehl, Henry M. Watson, Charles W. Wason, James H. McGraw and Otis W. Cutler. The speakers included Mayor Diehl, President Milburn and Director-General Buchanan, of the Pan-American Exposition; Charles Bissell, W. B. Rankine, Herbert B. Bissell, S. Fred Nixon and H. H. Vreeland.

On Wednesday, at the morning session, the papers named above, not disposed of at the Tuesday afternoon session, were taken up and discussed. In the afternoon trolley trips were taken to Niagara Falls, the Gorge Road, etc., and the power plants at the Falls were visited.

A number of interesting exhibits were made during the convention. The Keystone Electric Company, of Philadelphia, showed its voltmeters and ammeters. Harold P. Brown made a display of Edison-Brown plastic bonds. Mr. P. H. Alexander had an exhibit of the Compound Magnet Brake. The Speer Carbon Company made a good exhibit of its carbon brushes. The Edison-Johnson Electric Manufacturing Company showed a trolley hook intended to keep trolleys from leaving the wire. The National Carbon Company showed its various carbon specialties. Morris Electric Company had a collection of the various street railway goods that it handles. The Cutter Company, of Philadelphia, showed its I-T-E switches. The Gold Street Car Heating Company showed its electric car heaters, and the Consolidated Car Heating Company showed its electric heaters also. Couch & Seely Company, of Boston, had a neat display of its iron box telephone and other telephonic apparatus designed for street railway service. Mayer & Englund had a number of types of "protected" rail bond and other specialties. H. W. Johns Company showed its insulated line material. The Bierbaum & Merrick Metal Company had samples of its Ideal trolley wheel, and G. S. Allison exhibited models of his sectional steel pole.

An Instance of Trolley-Telephone Interference.

BY C. L. WOOLLEY.

I HAVE recently had a somewhat peculiar experience which apparently illustrates the leakage of currents from trolley lines into other circuits in the neighborhood, which may possibly be of interest to some of your readers. We have had for some years in operation a telephone line running from the store to the house, a distance of 800 to 1000 ft. On either side of the store and the house, at a distance of about 400 ft. from each, are two of the principal trolley lines of Baltimore City, Md. These lines run at right angles to the telephone wire. The telephone wire is run over roofs, suspended on porcelain insulators, and passing into the station at each end, is attached to a three-point switch, resting normally on the centre point, as below, and from this point through a vibrator bell to a gas-pipe ground. Of the remaining two points of the switch, one proceeds through battery to ground, and the other through transmitter, receiver and battery to ground. This line worked with perfect satisfaction for several years. A few weeks ago the bell at the house end, which, by the way, is of somewhat higher resistance than the other, began to ring at irregular intervals, and in a very peculiar way. It would in most cases tap slowly and faintly at first, gradually increasing, until in a few moments it was vibrating strongly. This would continue for a time, usually one or two minutes, and then gradually subside, or, in many cases, suddenly stop. Sometimes it would be silent for hours; sometimes it would ring at short intervals for hours; it would sometimes strike two or three blows at a time. A thorough search of every inch of the line failed to discover any contacts with any electrical sources, and as an experiment everything was disconnected from line save the plain circuit through bell at each end to the gas-pipe ground. This made no difference with the ringing, which continued as before. The line at this stage was useless for practical purposes, as one could not tell whether the "electrical ghosts" or the person at the other end of the line were ringing calls. Polarized magneto bells might have stopped the trouble. During further experimentation, while the bell was ringing, I touched the wire between the bell and the gas-pipe ground with the end of a wire from a water-pipe ground in the same building, and the ringing instantly stopped, but continued as soon as the water-pipe ground was removed. In five minutes I had cured the whole trouble by substituting a water-pipe ground for the gas-pipe ground at the house end, and leaving the gas-pipe ground as it was at the store. The gas pipe enters the house from the front; the water pipe from the rear, the run of each underground unknown to me. The relation of the line to the trolley lines is shown in Fig. 2.

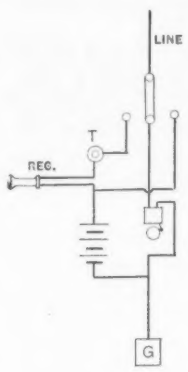


FIG. 1.

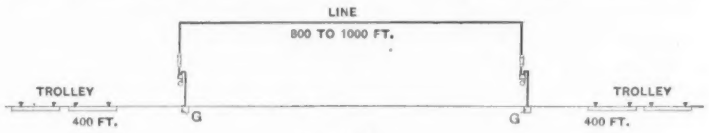
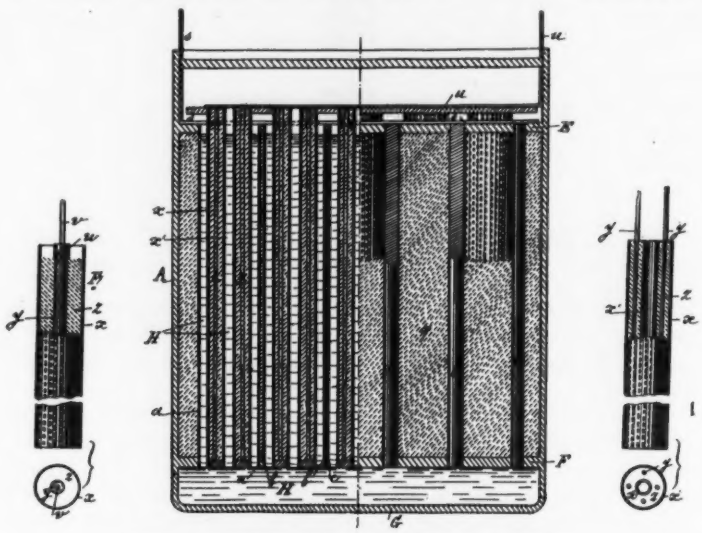


FIG 2.

"Cartridge" Storage Battery.

Messrs. V. Cheval and J. Lindeman, of Brussels, Belgium, have secured a patent on the "cartridge" type of storage battery shown herewith in Figs. 1, 2 and 3. One of the electrodes consists of a suitable number of cartridge-like devices, illustrated in Fig. 1. In the form of cartridge shown in this figure the active material *z* is placed in an envelope *x* of insulating material perforated with a great number of small holes, the envelope being closed at its lower end. Plunged into the active material, and in the axis of the cartridge, is a conducting-rod *y*, of carbon or of lead alloyed with antimony, provided at its upper end with a terminal *w*, provided with a thin lead rod *v* to be connected with the connecting bars or plates *u*. The form of these cartridges may be modified, as shown in Fig. 3. In this modification the active material *z* is placed between two envelopes *x* and *x'* of insulating material perforated with a large number of small holes and



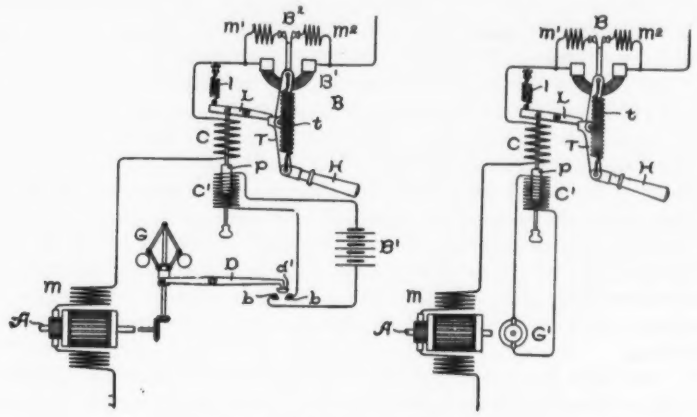
FIGS. 1, 2 AND 3.—CARTRIDGE STORAGE BATTERY.

resting upon an imperforate bottom. The electrolyte can enter the interior of the inner envelope *x'*. Into the mass of active material are plunged one or more conducting-rods of carbon or lead and antimony, which are connected to the terminal bars or plates *u*. The form of cartridge just described is illustrated as employed in the battery Fig. 2. The other electrode is formed in the following manner: Each of the cartridges described above is surrounded by an outer envelope of insulating material *a b c*, etc., Fig. 2. Such outer envelopes are perforated with a large number of small holes and are secured at their ends to two plates *E* and *F*, provided for this purpose, with large openings at suitable distances apart. These plates are supported by four vertical walls, Fig. 2, whose bottom *G* is at a certain distance from the plate *F*. In this construction the walls and bottom are imperforate. Between the several outer insulating-envelopes *a b c*, etc., and the walls, is packed active material *q*, in which rods or plates *s*. The walls *A B C* and bottom *G* contain the electrolyte *H*, which being introduced into the spaces between the insurods or plates *s*. The walls *A B C* and bottom *G* contain the electrolyte *H*, which being introduced into the spaces between the insulating envelopes *a b c*, etc., and the cartridges contained therein, comes into contact at the same time with the two sets of electrodes. Instead of constructing the battery so that the walls *A B C D* and bottom *G* contain the electrolyte the electrodes constructed as described may be placed in an external receptacle *r* to receive the electrolyte.

Speed Governor for Electrically Propelled Vehicles.

Mr. H. F. Parshall, the American electrical engineer, who has been so actively engaged the last few years in electric railway work in England, has secured a patent on an automatic speed governor for electric cars, etc., the application for which was filed in June, 1897. It is illustrated herewith. In Fig. 1 *A* is the shaft of the motor, and *B* is a circuit-breaker inserted in series with the motor armature. This circuit-breaker here shown is of the Potter G. E. type, though the invention may be adapted to other kinds. In the particular form illustrated the circuit-breaker comprises a switch *B'*, with an auxiliary switch B^2 in multiple therewith controlled by a handle *H* through a toggle *T*. The spring tends continuously to open the circuit first at *B'* and then at B^2; but this tendency is withstood by the action of the latch *L*, controlled by a spring *l*. When the current in the coil *C* rises to a certain predetermined amount, the latch *L* is attracted downward and the spring *t* is allowed to withdraw the brush *B'* from the contacts. This causes current to flow through the magnet-coil $m' m^2$, so that by the time the final arc is formed at the contacts B^2 a field exists of sufficient strength to extinguish it. Mr. Parshall provides a tripping-coil *C'* upon the circuit-breaker, acting upon the armature *p* and tending when energized to draw down the latch *L* and allow the spring *t* to open the circuit. This coil is connected in series with an auxiliary source of electromotive force, here shown as a battery *B'*, through the stationary contacts *b b* and the movable contact *d'*. This movable contact is actuated through the lever *D* by the governor *G*, which is in some manner run at a speed corresponding to the speed of the motor. If the speed of the motor rises too high, the contact *d'* is closed and the coil *c'* is caused to trip the circuit-breaker *B*.

In the form shown in Fig. 2 there is shown as an auxiliary source of electromotive force a generator *G'*, which is mounted on the shaft of the motor *A*, or is in any other way driven at a speed correspond-



FIGS. 1 AND 2.—SPEED GOVERNOR.

ing to the speed of the motor. This generator is connected directly in series with the auxiliary tripping-coil *C'*. Whenever the speed of the motor rises above a certain point, the electromotive force generated by the auxiliary generator *G'* becomes sufficient to cause the auxiliary tripping-coil to act, and thus opens the circuit of the motor.

It will be evident that with either of the forms shown it is impossible for the attendant to close the circuit-breaker in such a way that it will remain closed until the speed of the motor or of the apparatus driven by the motor has been reduced to the proper value.

A Telephone Relay.

Mr. W. G. Urmson, of New Brunswick, N. J., has recently secured a patent on a telephone repeater which will act in all respects as does a telegraph repeater. It is also available as a booster, *i. e.*, it can be inserted in a bridge across the circuit between the telephone terminal stations, operating on the current which has arrived from the transmitting station and sending out such currents in amplified form to the receiving station. It is stated that "the results which have been attained with this apparatus are remarkable," and that "conversation has been carried on over an amount of wire much greater than was heretofore possible."

Mr. Urmson discovered that in telephonic repeaters a microphone which is adjusted by tension as distinguished from compression and which has an air-space between the electrodes gives altogether remarkable and striking results. The characteristic of such a microphone, of the Lockwood type, is to be found in the fact that the electrodes are separated by an air-space, but are surrounded by granular material, the electrodes being held apart by suitable tension devices acting on the plates or diaphragms to which they are secured. Motion of the electrodes toward or from each other in such a construction is very free, being merely retarded by the friction of the granular material, which acts as a bridge between the electrodes. Another important feature lies in the fact that he uses electromagnets on the opposite sides of the microphone and combines such electromagnets each with an induction coil the primaries of which are connected in a common local-battery circuit including the microphone. He thus secures not only the double action of two electromagnets on a common micro-

phone, but also a building-up effect of the current through the induction-coils and microphone. He can also mount the electromagnets on the opposite poles of a permanent magnet, thus acting to increase and decrease the inherent magnetism of the poles by the telephonic currents; or he may use a pair of magnets on each pole and connect them oppositely in pairs.

Aside from the above features, the invention relates to certain improved mechanism which secures the adjustment at the proper tension of the electrodes of the microphone which are separated by an air-space. It is necessary for proper operation that these electrodes be adjusted to a very precisely determined position—a critical point of poise. At such position of adjustment the microphone will act with great force and snap. The invention permits of this ready adjustment.

Fig. 1 is a diagram of the circuit connection of the system when used as a repeater. Fig. 2 shows a diagram of these same circuit connections when the device is used as a booster. In Fig. 1 there is a permanent horseshoe-magnet *N S*, on the poles of which are mounted two electromagnets *f f'*. Between these electromagnets and on a base-plate *A* there is secured a microphone composed of two electrodes *a a*, each attached to diaphragms *b b*, which are preferably of mica, the diaphragm being surrounded by an annular shell *c*, enclosing a quantity of granular material *d*, which is, however, not permitted to fall into the space between the electrodes The electrodes are held apart at a very precisely determined position of adjustment by suitable tension devices. Soft-iron armatures *e* are secured to the diaphragms or the electrodes. The pole-pieces of the electromagnets *f f'*, acting on the armatures *e*, tend to pull the diaphragms apart. This tendency is balanced by the tension devices. It will, therefore, be seen that under normal conditions the electrodes of the microphone are in a very delicate position of poise and at what might be called a "critical" point of poise, so that the slightest variation in the electromagnetic force of the pole-pieces will produce most pronounced effects.

The line 1 passes through the fine-wire secondary 2 of an induction-coil 10, through the electromagnet *f*, and back to the original station or to the ground. The line-wire 3 passes through the fine-wire secondary 4 of an induction coil 11, thence through the electromagnet *f'*, and back to the station from which the line came, or else to the ground. The local circuit 8, in which is found the battery 7, contains two primaries 5 6, shown as in series with each other, which co-operate, respectively, with the secondaries 4 2 in the lines 3 1. As is well understood, the phase of the current coming over the line 1 and passing through the secondary coil 2 is 180 degs. apart from the phase of the current which is thereby generated in the primary coil 6. The phase of the current in the coil 6 is the same as the phase in the coil 5, and this again is 180 degs. apart from the phase induced in the coil 4. It follows that the phase of the current in the coil 2 of the line 1 is

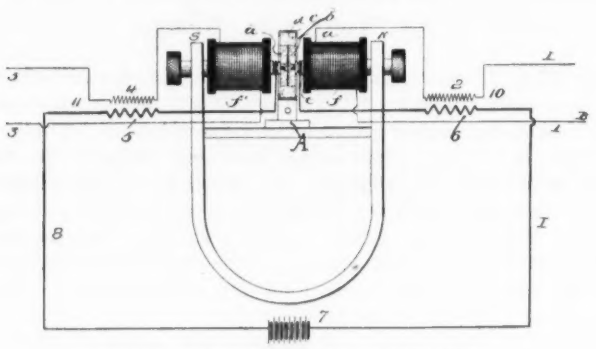


FIG. 1.—TELEPHONE RELAY AS REPEATER.

the same as the phase of the current in the coil 4 of the line 3. It is to be noted that the local-battery circuit 8 passes not only through the primaries 5 6 of the induction-coils 10 11, but also through the microphone-electrodes *a a* and the granular material *d* surrounding them. The electromagnets *f f'* must act in conjunction—that is, both electromagnets must act to pull apart the electrodes at the same time. Since the phase of the currents in these electromagnets is the same, and since these electromagnets have pole-pieces which are of opposite polarity, it is, therefore, necessary that the windings of these electromagnets should be oppositely connected, and this is indicated in the drawings. When the current comes over the line 1 and passes through the electromagnet *f*, the current which is induced by means of the two induction coils 10 11 into the electromagnet *f'* will cause both of these magnets to act simultaneously either to increase their magnetisms to simultaneously pull the electrodes apart or to decrease their magnetisms to allow the electrodes to move together. In either case the variation of the resistance brought about in the local circuit 8 by the operation of the microphone will act to reinforce the variation of current already brought about in the local circuit by the inductive action of the induction coils 10 11. Thus if there be an increase of the current in the line 1 and electromagnet *f*, which by the inductive action of the coil 10 will generate a decreasing current in the local circuit 8, the same increase of current in the electromagnet *f* will act to pull apart the electrodes *a* to increase the resistance of the microphone and to diminish the current flowing in the local circuit. Mr.

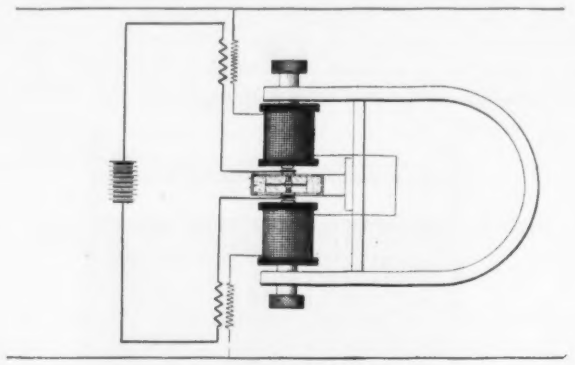


FIG. 2.—TELEPHONE RELAY BOOSTER.

Urmson thus gets by the action of the microphone and its operating-magnets and the induction coils his "building-up effect," which is most marked and striking, and which adds much to the efficiency of the repeater.

It is clear that the action of the arrangement shown in Fig. 1 is reversible. Weak telephonic currents which arrive over the line 1 are converted into strong telephonic currents which depart over the line 3; but at the same time weak telephonic currents which arrive over the line 3 may be converted into strong telephonic currents which go out on the line 1. While there is shown a single electromagnet on each side of the microphone, it is clear that a pair of electromagnets might be used instead of a single electromagnet. Such magnets might be connected in parallel or in series, or the magnet *f* on the north pole of the horseshoe-magnet might be connected in series, but in the opposite direction, with a magnet on the south pole of the horseshoe-magnet.

Other details of the patent and drawings relate to their use as a booster and to the method or function of enabling a series of microphones connected in series or parallel to have the tension of their respective electrodes adjusted readily, each independently of the other and without interference; there being a particular position and "poise" at which the action of these microphones is most pronounced.

Exchange Telegraph Plans.

The committee having in charge the formation of the Exchange Telegraph Company, which is to be constructed by the Chicago Board of Trade, has instructed its attorney to proceed with the incorporation under the laws of New Jersey. The company is to have a capital of $5,000,000. The Chicago Board of Trade officers are to make a contract with it, giving it the exclusive telegraph privileges of the Exchange floor and building for 25 years. It is also proposed to give it the exclusive privilege of distributing market quotations for 25 years outside the city of Chicago. It is the aim of the committee to secure similar contracts regarding Exchange space privileges, and to contract for supplying the Chicago markets for a like period from all other exchanges of the country. A proposition is also being considered in connection with the Exchange business to arrange to transmit letters of 100 to 200 words from Chicago to New York at night for $1, the letters to be mailed at the latter point and reach destination on the folowing day.

Telephone Consolidation on the Pacific Coast.

The Pacific States Telephone & Telegraph Company, which has its principal offices in Portland, Ore., and is capitalized at $15,000,000, recently took over the lines formerly composing the Sunset Telephone system, with headquarters in San Francisco. John I. Sabin is president, and John C. Ainsworth vice-president of the new corporation.

The companies absorbed are the Pacific Telephone & Telegraph Company (of San Francisco), Sunset Telephone & Telegraph Company, Inland Telephone & Telegraph Company, and Oregon Telephone & Telegraph Company. The lines absorbed extend from British Columbia to Mexico, and also penetrate those countries for short distances. Numerous extensions are to be made.

CURRENT NEWS AND NOTES.

AGRICULTURE.—A syndicate has been formed at Ochsenfurt, Bavaria, to apply electricity in agriculture.

MR. GEORGE G. WARD, the vice-president of the Commercial Cable Company, of New York City, has had the order of the Crown of the Second Class conferred on him by Emperor William of Germany. The recipient of the honor is an Englishman by birth and an American of long adoption.

SIEMENS & HALSKE COMPANY'S MEDALS.—It is stated that the Siemens & Halske Company, of Berlin, has received at the Paris Exposition 12 grand prizes, 11 gold medals, 21 silver medals and 7 bronze medals. It is believed this is the largest number of awards given to any single company.

A GRACIOUS PRESIDENT.—London *Lightning* has some very amusing, and a few satirical remarks on the joint Institute meeting in Paris, and in speaking in praise of the reception by the A. I. E. E. and its hearty cordiality, says: "There was Carl Hering, who could teach some of our presidents how to receive graciously, not only the larger and more important personages, but also the lesser ones of the earth."

WEATHER BUREAU FOR GERMANY.—Consul-General Guenther, of Frankfort, says: "The German agriculturists have expressed the wish to have a meterological signal service established, and the German Government is inclined to comply. A meeting of Government officials and meterological and agricultural authorities is soon to take place at Hamburg, to discuss the introduction of a telegraphic service for German agriculture.

CABLES OPENED TO CHINA.—The various cable companies in New York have announced that the Shanghai-Chefoo cable established by the Eastern Extension and Great Northern companies has been opened for international correspondence in direct communication with the previously established cables from Chefoo to Taku, to Port Arthur and to Wei-Hai-Wei, thus creating with each of these stations commmunication with China independent of the land lines controlled by the Chinese Government.

FROM BOSTON BY TROLLEY.—A party of 20 persons, composing the first trolley excursion from Boston to New York, started from Post Office Square, Boston, at 8:45 a. m. on Monday, Sept. 24. Robert H. Derrah, the originator of the trip, was in charge. A porter and a matron also accompanied the party. The route, as mapped out, lay through Newton, Natick, South Framingham, Marlboro, Worcester, Springfield, Hartford, New Britain, Meriden, New Haven, Bridgeport, Norwalk and Stamford. The schedule should bring them into New York City about 4:20 p. m. on Wednesday.

MOTOR VEHICLE.—In our last issue details were given of some of Mr. Clyde J. Coleman's work in the automobile field. Another patent has also just been issued to him in the same line. Its object is, broadly, to provide a simple and efficient system of current control for varying the speed of the vehicle motors, in which the multiple-wound armatures and the batteries are capable of being independently arranged in series, in multiple and in series-multiple groupings, so as to afford a very extensive range of control without involving the employment of variable resistances or rheostats with their consequent waste of energy.

PRIZES AT PARIS.—The contestants for the prize offered by the executors of the estate of Anthon Pollok for the best life-saving device in a marine disaster have protested that the examination by the jury formed in Paris was unsatisfactory and unbusinesslike. They say their exhibits were not tested and were not removed from their cases. The decision of the jury was that none of the exhibits was worthy of a prize. The jury also refused to allow the exhibitors anything for expenses. The contestants say that it was promised that their expenses would be paid. Anthon Pollok was a resident of Washington, D. C., and a lawyer of prominence and was much interested in electrical patents and inventions. He and his wife were lost in the disaster to the steamship La Bourgogne. His money went to cousins who believed that the offering of a prize of $20,000 for a life-saving device would be a good way of perpetuating his memory.

AUTOMOBILE TAXES IN SPAIN.—Vice and Acting Consul Geary reports from Malaga, Aug. 18, 1900: "I give below a résumé of the new order relative to the local tax on automobiles, as follows: The better class of private automobiles will pay, in cities having a population of 100,000 or more, a tax of 80 pesetas, or about $11.58, for each vehicle, and for each seat, including that of the conductor, 9.40 pesetas ($1.36). In cities having from 20,001 to 99,999 inhabitants, a tax of 40 pesetas ($5.79) for each vehicle will be charged, and for each seat of the same 4.76 pesetas (69 cents). In other places of less than 20,000 people, the taxes are 20 pesetas ($2.89) for each vehicle and 2.35 pesetas (34 cents) for each seat. Automobiles for traveling along the public roads will pay, for each kilometer (0.62 mile), 4 pesetas (58 cents), and for each seat and kilometer of travel, 0.25 pesetas (3.5 cents).

ELECTRIC RAILWAYS IN CANADA.—Mr. George Johnson, the Dominion statistician at Ottawa, has compiled some very interesting figures about the electric railways of Canada. During the year ended Dec. 31, 1899, the 612 miles of electric railway track were so used that the total number of miles run by cars was 20,646,847. The number of passengers carried was 104,033,659. This is equal to moving every man, woman and child in the Dominion about 20 times. The mileage run and the passengers carried show that for each mile run the electrics carried 3½ passengers. Compared with the previous year, the number of passengers carried increased nearly 9,500,000, and the number of miles run by over a million. The amount of paid-up capital invested in electric railways in Canada is $21,700,000. The electric cars traveled over 4,333,000 more miles than the passenger and mixed trains of the steam railways. Together, the steam and electric railways carried over 120,000,000 passengers, and the proportion was about 13 by steam to 87 by electricity.

CABLE SERVICE AT PERNAMBUCO.—In a recent report Mr. E. N. Gunsaulus, U. S. Consul at Pernambuco, Brazil, says: "This city now takes first rank as a cable station in South America, and has lately made material improvements in its submarine telegraphic service. It has no less than ten cable lines to various parts of the world. There were formerly three cable companies here, but recently two of them were consolidated. The present companies are the Western Telegraph Company, Limited (English), and the South American Cable Company. The first-named has a very complete system and is now finishing two or three new lines to Brazilian ports. One of these is a through line to Para; another to Para, touching at local points, and still another to Rio de Janeiro. It now has distinct lines running to Para, Ceara, Rio and Bahia; two to St. Vincent, Cape Verde Islands, and one to Europe via Lisbon, Portugal. Several of these cables are duplexed, while another line to Rio will be triplicated to Montevideo. These lines are constructed according to the latest scientific improvements, and some of them have a carrying capacity of 200 letters a minute. The rate for messages from here to New York, via Europe, is about $1.15 per word. The Western Company has 50 people constantly employed here as an office force. The South American Cable Line touches several South American points, going thence to the Canary Islands, Cadiz, Spain, and Africa."

MANUFACTURING NITROGEN COMPOUNDS.—Mr. C. B. Jacobs, of East Orange, N. J., has assigned to the Cyanide Company, of New Jersey, and the Ampere Electro Chemical Company, patents on manufacturing nitrogen compounds. The earlier invention consists broadly in the production of a porous carbide by providing in the mass of carbide cores, bases or lumps of comparatively infusible material on which the carbide is distributed, with intervening interstices; and in the treatment of this porous mass with nitrogen at a suitable temperature to induce chemical action, more particularly in

the treatment of barium carbide. In the later-patented process, Mr. Jacobs makes a porous carbide composition of an extreme degree of porosity and of unusually high carbide percentage in the material exposed to the action of the nitrogen; and such porosity and high percentage of carbide result from the formation, as a preliminary step in the process, of a coked mixture containing an alkali-earth material—say, barium carbonate—impregnated throughout its mass and in most intimate contact with its cell-walls, so as to favor the combination of the carbon-producing elements to the greatest possible extent. The process is carried out as follows: Barium carbonate is mixed and finely ground with an amount of coking-coal sufficient to furnish an excess of carbon over that required for the manufacture of barium carbide, the proportion, by weight, being three parts of barium carbonate to two parts of soft coal. This mixture is then subjected to a coking-heat in an ordinary retort-oven. The resulting material is a porous mass of coke, into the cell-walls of which the barium carbonate is firmly fixed or cemented by the coking process. The material is charged into a rotary continuous electric furnace, and subjected to heat sufficient to form barium carbide. A furnace of this kind, of usual size, producing one ton of carbide per day, will require a current of about 1500 amperes at 100 volts. The barium carbide melts over the particles of coke present in excess and forms a porous carbide composition, which, after it passes the zone of highest heat in the rotary furnace, solidifies, and then is subjected to the action of nitrogen or nitrogen-bearing gas, which at a temperature below the fusion-point of carbide is rapidly absorbed by the carbide converting the latter into barium cyanide. It will be understood that when the mass cools below the fusion-point of the carbide the said mass will still be porous, owing to the separating and sustaining effect of the excess of carbon in the mass, and this carbon being in the extremely porous form of coke, with the carbide distributed over its cell-walls, a maximum surface will be presented to the action of the nitrogen. The barium cyanide may be used as such or may be converted into various other nitrogen compounds by ordinary chemical means. The heat energy of the electric furnace is sufficient to form the porous carbide composition and also, as the furnace cools down, to sustain the carbide for a considerable time at the temperature required for the absorption of nitrogen by the porous carbide. The operation is continuous and automatic from the point at which carbide is formed from the raw materials until the cyanide is discharged from the electric furnace. In the coked mixture charged into the furnace the contact between the carbon and the barium carbonate is extremely intimate, and forms a higher yield of carbide for the heat expended than the ordinary mixtures do, and thus a corresponding increase in the yield of cyanide produced.

LETTERS TO THE EDITORS.

The Design of Tractive Electromagnets.

To the Editors of Electrical World and Engineer.

Sirs:—For the benefit of such of your readers as may be led astray by the erroneous criticisms of Mr. Lamar Lyndon in your issue of Sept. 15, I desire to say that the method of employing a conical adjustment of plunger is due to Mr. F. J. Sprague. Mr. E. R. Carichoff called attention to this arrangement of parts in your issue of Aug. 11, 1894, and pointed out that if the polar area is doubled by using male and female cone plunger, the travel of the plunger is increased four times, providing the reluctance of the plunger air gap remains constant. Constant plunger air gap reluctance insures the same total flux, and the same capacity for *work;* but if the air gap area is doubled by using the conical plunger, the initial pull will be decreased to one-fourth of its original value, and the plunger travel increased four times. This change is due to the reduction in air gap flux density with the increase in air gap area.

W. E. GOLDSBOROUGH.

LAFAYETTE, IND.

Progress in Electric Lamps and Arc Light Carbons.

To the Editors of Electrical World and Engineer.

Sirs:—Mr. Blondel's paper at a recent Paris congress, on which you report in your last issue of Sept. 22, is certainly worthy of study by the electrical trade. The closing sentence of your notice on arc light carbons—"Let our good Yankee makers arise and see things, and also take steps to drive the foreigners out on their merits"—sounds very nice and patriotic; but when this can only be done, as was attempted by the carbon trust, at a ridiculous protective duty of $9.00 per thousand, we Yankees have no reasons to be proud of the domestic carbon manufacturer's ingenuity.

It may be that the American station managers "grow green with envy" when they hear about prices, as mentioned in Professor Blondel's paper, but they have to remember that when they have to pay a higher price for the imported article, which is admitted to be the best, and the only one that so far will give the best satisfaction—to which the station managers are justly entitled—they simply pay for the protection which the domestic carbon manufacturers enjoy under the "Dingley Tariff bill."

At the time this bill was in discussion, it was suggested in this paper that the central stations should endeavor, through representation at Washington, to have a reasonable duty put on carbons, an article of the greatest importance in the development of electrical machinery and arc lamps, in so far as the final object of these apparatus is the production of light, that can only be obtained through the medium of the carbons.

The utter indolence of the central station managers, who permitted domestic carbon manufacturers, who afterward formed the carbon trust, to dictate the absurd duty of $9 per thousand carbons to the committee which was chosen to compromise between the proposed duty by Congress of 30 per cent ad valorem, and the one of 50 per cent as suggested by the Senate, was certainly most remarkable; but while they let the carbon trust have all its own way, they can blame but themselves for having to-day to pay the higher price and help the trust to pay its dividend on an inflated capitalization.

OBSERVER.

NEW YORK CITY.

New Ideas and Old Terminology.

To the Editors of Electrical World and Engineer:

Sirs:—In the ELECTRICAL WORLD AND ENGINEER of Sept. 15 is a letter from Mr. F. W. Darlington, in which he expresses his dissatisfaction with the modern way of looking at electrical energy. There are some grounds for his difficulty, due, in my judgment, to the lack of adjustment between old terminology and new conceptions derived from more complete knowledge. Until within a few years, electrical energy was considered to be transmitted through a wire by a process called conduction. It was imagined to be a process analogous to heat conduction, though with a velocity of thousands of miles in a second. The effects of a current upon a neighboring conductor were called inductive, and no one concerned himself much with the question as to the nature of inductive action.

With the discovery of the significance of the ether as the medium of inductive action, there seems to have been a kind of stampede to the ether, with the attempt to show that all electrical phenomena are ether phenomena, and the importance of conductors has been minimized so it is a common statement now that electrical energy travels altogether through the ether and that a wire serves only as a kind of directrix. This, too, when one of the primal facts in the science is that electricity will not pass through a vacuum—that is, ether void of matter.

I do not know that any one has ventured to assume that electrical energy exists independent of electricity; and if electricity, whatever notion one may entertain as to its nature, cannot get into the ether, then how can electrical energy get into the ether?

Here is where the trouble arises: failure to make the proper distinction between conduction and induction, one being a function of matter, the other of the ether. The difference will be more clearly discerned by considering the entirely similar case of heat and radiant energy. A heated body may lose its heat in two ways, by conduction, that is, by contact with another body having a lower temperature, and by radiation. In radiation the heat is *transformed* into ether waves and these are transmitted outward with the velocity of 186,300 miles per second, but the ether is not heated. There is no heat as such in the space between the earth and the sun, though there is an enormous amount of energy which originated in a heated body. Formerly this radiant energy was called radiant heat, but nowadays nobody calls it so who recognizes what has happened. Heat energy and radiant energy are two entirely different forms of energy; as much different as are the mechanical energy of a rifle ball and the heat which results from its impact upon the target, or as the chemical energy of coal and

the heat derived from it on combustion. We have just fairly got rid of the term radiant heat, and have adopted in its place the term radiant energy. The idea of heat, as such, is gone, for the ether cannot be heated.

If one has an electrified body one may be sure it is a mass of matter, not a body of ether, and terminology ought to conform to the facts.

Again, it is agreed that what is called an electromagnetic field is the ether in a state of stress produced by what we call a current in a conductor. A mass of matter is an essential condition for its existence and maintenance. It is the condition of the matter that produces the stress in the ether, that is, the magnetic field. We do work on the mass of matter to produce the electrical energy, and the electrical energy does work on the ether producing the stress. We do not call the energy of a steam engine that drives a dynamo electrical energy; we call it mechanical energy. Why should we call the energy in the ether electrical energy, because its antecedent was electrical energy? There is as much of a transformation of the energy in the latter case as in the former, and, in my judgment, whenever energy of any kind has been transformed it should have an appropriate and distinctive name.

At present we have only radiant energy as a name for what gets into the ether, but common terminology has it that the energy in an electromagnetic field *is* electrical energy.

Once more, all physicists entertain now the doctrine of the electromagnetic theory of light, and show how ether waves of any length may be set up. What they will do depends only upon the kind of matter they fall on. The same waves that excite vision will heat other matter or produce chemical action, fluorescence, etc. If the ether waves are alike except in length, then long waves as well as short ones are radiant energy, and there is no more need for calling them electrical because they may produce electrical phenomena than there is for calling shorter ones heat or light or chemical waves because they may produce heat, light or chemical effects, and these, as I have said, have been abandoned, and Prof. Newcomb has suggested that we abandon the use of the word light for such waves as produce vision. The meaning of all this is that there is energy in the conducting wire as well as in the field about it, and the form of the energy is different in the two substances, the matter and the ether. For one of these we have the common name electrical energy, for the other there is none, and for the lack of an appropriate name, both are called by the same name, which is improper and inconsistent with settled use in allied fields.

It cannot be right to assume that the molecules of all matter are as far apart relatively as the planets are from each other. In the air at its density next the earth the average distance apart is of that order, as a little computation will show. Molecules of oxygen have a diameter approximately the fifty-millionth of an inch, and their average distance apart is about two hundred times their diameter. The diameter of the moon is, say, 2000 miles, and two hundred times that would be 800,000 miles; but the sun is nearly ninety-three millions of miles away, and Neptune nearly three thousand millions. In solids and liquids, molecules are more or less in contact and colliding all the time millions of times a second; so electrical phenomena in such bodies can hardly be compared with electrical phenomena in bodies always apart. In one conduction is possible, in the other impossible. In case of separation, inductive stress is set up, and this means a transformation of energy and implies the need for a new name.

TUFTS COLLEGE, MASSACHUSETTS. A. E. DOLBEAR.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Temporarily Conducted by E. F. ROEBER, Ph. D.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

Induction Motors.—EBORALL.—A reprint in full of his paper (Digest, June 16). Lond. *Elec.*, Aug. 17, 24, 31; a reprint in full of the discussion which followed in Lond. *Elec.*, Sept. 7.

Theory of Dynamos.—WESTPHAL.—A mathematical article, illustrated by diagrams, on the laws governing the distribution of the lines of magnetic induction over the circumference of a dynamo.—*Elek. Zeit.*, Sept. 6.

Dynamo Output.—OGLESBY.—An elementary article on "some methods of determining dynamo and motor output." He develops the fundamental formula for the voltage of a dynamo, as depending upon the magnetic field, the number of armature conductors in series and the speed. He further discusses briefly the factors which determine the safety limit of current which the armature conductors may carry.—*The Eng.*, Sept. 15.

Care of Direct-Current Dynamos.—HERTNER.—An illustrated article giving some "hints on the care of generators and motors," especially on the setting of the brushes.—*The Eng.*, Sept. 15.

LIGHTS AND LIGHTING.

REFERENCES.

Manufacturing Incandescent Lamps.—A description of the Malignani process of exhaustion. A certain degree of exhaustion is accomplished by pumping, while the refinement of the vacuum is obtained by a special chemical process, which is described.—*L'Ind. Elec.*, July 25.

POWER.

Lausanne.—An article on the projected electric power station for supplying current to Lausanne for lighting and power purposes. The hydraulic power plant will be erected at St. Maurice, a distance of 35 miles from Lausanne. For transmission the high-tension, direct-current series system will be used, and for the distribution in Lausanne the three-phase system. The power plant will contain five turbines, each of 1000 horse-power, each driving two direct-current generators furnishing a constant current of 150 amperes; these 10 generators are connected in series, the whole voltage depending upon the load, and being 22,000 volts for full load. This direct current will be transmitted to a sub-station near Lausanne, where it will be converted by motor-generators into three-phase current at 3000 volts, which is distributed by underground cables through the city to 30 transformers for transformation down to 125 volts, at which pressure it is supplied to the consumers.—*Elek. Neu. Anz.*, Sept. 1.

Electric Power for Agricultural and Industrial Purposes.—An editorial on "an industrial object lesson." A short time ago an electric plant, using water-power of the River Isar, was started at Hoellriegelsgerent, an insignificant village near Munich, Germany. The plant has four turbines and an aggregate rating of 2000 horse-power, exclusive of some 1000 horse-power in reserve steam plants. The power is supplied over an extensive rural area for agricultural and other industrial purposes; 25 firms and in all 90 premises of various kinds are now supplied with light and power, the area covered including 21 villages and rural districts. The load is composed of 151 motors, 13,500 incandescent lamps and 329 arc lamps. It has been decided to provide 4000 additional horse-power at the power plant. An entirely new industrial district has thus been created by the establishment of cheap electric power supply. The most striking feature of the undertaking is the creation of a vigorous competition between this new electrical area and the city of Munich, in regard to the location of factory sites; not only have new works sprung up within the electrical area, but established works in Munich have been abandoned, their industries being transferred from town to country. The real explanation of this industrial development is said to be the existence of a large source of water-power.—Lond. *Elec.*, Sept. 7

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Electrical Traveling Cranes.—HILL.—An illustrated article in which he shows in diagrams the successive steps in the development of the electric traveler, and discusses single-motor cranes, multiple-motor cranes and controllers.—Lond. *Elec. Rev.*, Sept. 7.

Electric Traveling Crane.—A description of a 50-ton crane of Adamson & Company, with a separate reversing motor for each motion.—*Eng'ing*, Jan. 5; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 141, Pt. 3.

Driving Weavers' Looms.—An illustrated article on the driving of weavers' looms by three-phase motors.—*Elek. Anz.*, Sept. 6.

Power Consumption of Rolling Mills.—An article in which the results of tests are given, made in a steel plant, on the consumption

of electric power during the rolling of a 9-in. joist and of a 12-in. beam.—*Iron Age,* Sept. 13.

Driving Dynamos.—Schindler.—An illustrated article discussing different points in the methods for driving dynamos.—*Elek. Anz.,* Aug. 23, Sept. 6.

High Furnace Gases for Power.—Donkin.—A series of descriptions and general plans of some large gas engines adapted to use high furnace gases.—*Engineer,* Nov. 24, Dec. 8, 15, 1899; abstracted in *Brit. Inst. Civ. Eng. Abstracts,* v. 141, Pt. 3.

Canadian Water-Power Plant.—Child.—An illustrated description of the 12,000-hp hydraulic power station of the Lachine Rapids Hydraulic & Land Company, which furnishes current for lighting Montreal and for power purposes.—*Elec. Rev.,* Sept. 12.

Traction.

Regulating the Speed of Traction Motors.—Reyval.—An illustrated description of the "Solignac compensator," which is a device for starting a traction motor and for regulating its speed, without wasting energy in inserted resistances. He remarks that this is of importance, especially for automobile motors. The principle of the device is seen in the first figure, where *B* is the series-wound traction motor, while *A* and *C* form a motor-generator, *A* being the motor end and *C* the dynamo, their armatures turning around the same axle; *A* is series wound, *C* shunt wound; the connections are shown in the diagram. The principle of the controller is shown in the second diagram, where the cross-hatched surfaces represent metallic contact surfaces; the plate, shown at the right-hand of the diagram, is moved from the right to the left-hand so that different connections are produced. In starting, when line 1 reaches the contact blocks, the current goes through *A* and *B*, while the field and armature of *C* are disconnected. The motor *B* starts slowly, on account of the resisting torque, while the motor *A* starts quickly, as it is not loaded; it, therefore, gets

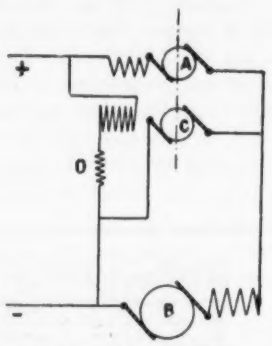


FIG. 1.—COMPENSATOR.

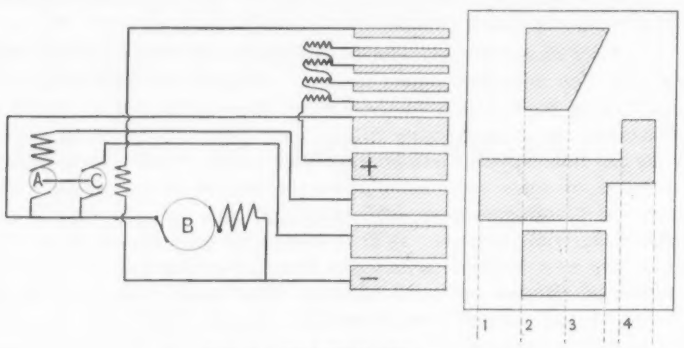


FIG. 2.—COMPENSATOR.

nearly immediately a speed sufficient to produce a counter e. m. f. which is great enough to prevent an excessive current. When by moving the controller further, the line 2 touches the contacts, the field and the armature of *C* are connected to the circuit, the field of *C* is excited and in its armature a current is induced which is supplied to the main motor *B* and increases the current supplied by the accumulator battery, or whatever is the prime source of current. When by moving the controller further, the line 4 touches the contacts, *A* and *C* are switched off and the motor *B* is supplied direct from the battery. For starting the controller must be quickly turned over the position 3, as this is to be used for decreasing the speed; as shown in the diagram, by moving the controller slowly from the position 3 to 4, gradually, resistances are inserted into the field circuit of the dynamo *C;* therefore, the field of *C* is weakened, and the load of the motor *A* decreases; hence the speed of *A* increases and the voltage at the terminals of *B* diminishes, and its speed decreases. He gives diagrams which show that this device consumes much less energy than a rheostat; it is also of smaller size; its weight, however, is greater.—*L'Eclairage Elec.,* July 28; more briefly in *Elek. Neu. Anz.,* Sept. 1.

Polyphase Electric Traction.—Carus-Wilson.—A long, illustrated abstract of a paper read before the Brit. Inst. of Mech. Eng. While the direct-current motor shows a large reduction in speed at heavy loads, the polyphase motor runs at a practically uniform speed independent of load or grade; thus a railway equipped with polyphase motors can carry a temporary increase of traffic without influencing in any appreciable degree the scheduled speed, the only exception being that an increase of load affects the time of starting. He gives a long description of the Burgdorf-Thun railway and gives in diagrams and in a table the results of tests made with the object of ascertaining the ability of polyphase motors to get up speed under ordinary conditions of railway service, and the economy obtainable in so doing when compared with that observed with the best direct-current motors; the tests were made on the Burgdorf-Thun railway and on the South Side Elevated R. R. at Chicago; the direct-current equipment can get up a speed of 23 miles per hour with 34.7 watt-hours per ton in 30 seconds, as compared with 41.5 watt-hours in 28 seconds with the three-phase equipment; similarly, the direct-current motors get up 24 miles per hour with 39.5 watt-hours in 37 seconds, as against 45.1 watt-hours in 30 seconds for the three-phase motors; the maximum power input as obtained in actual practice with the three-phase motor is only 70 per cent of that with the direct-current motor. He then discusses the general features of the polyphase motor and gives some details of Burgdorf-Thun motors.—*St. R'y Rev.,* Sept. 15.

REFERENCES.

London.—A well-illustrated article on the City & South London R'y.—Lond. *Elec. Rev.,* Sept. 7.

Portland.—Fairchild.—A long, illustrated article on the electric street railways of Portland, Me., and vicinity.—*St. R'y Rev.,* Sept. 15.

Elmira & Seneca Lake R'y.—An illustrated description of this recently opened trolley line.—*St. R'y Rev.,* Sept. 15.

Moving Platforms.—Perry.—A communication in which he says that he had invented, about 20 years ago, a method of entering and leaving moving trains, which is analogous to the principle of moving platforms.—*Nature;* Lond. *Elec.,* Sept. 7. (See E. W. & E., Sept. 22.)

Electric Traction on Main Railways.—Heft.—A reprint of a portion of his report made to the Internat. Tramway Congress at Paris in 1900.—*St. R'y Rev.,* Sept. 15.

Power Station Design.—Dawson.—A long abstract of the paper noticed in the Digest July 28.—*St. R'y Rev.,* Sept. 15.

Power House Diagrams.—A reproduction of the power house records of three British tramways, noticed in the Digest Aug. 4.—*St. R'y Rev.,* Sept. 15.

Storage Batteries for Automobiles.—Loewenthal.—An article giving rules for laymen how to manage and to care for storage batteries.—*The Automobile,* September.

Installations. Systems and Appliances.

Tonsberg.—Rasmussen.—A description of the electric lighting and power plant of Tonsberg, which is the first town in Norway in which gas has been adopted as driving power, the gas being made on Dowson's plan. There are two gas engines, each driving two shunt dynamos of about 11 kilowatts, and a battery giving 455 ampere-hours if discharged in 10 hours.—*Teknisk Ugeblak* (Christiania), Sept. 21, 1899; abstracted at some length in *Brit. Inst. Civ. Eng. Abstracts,* v. 141, Pt. 3.

Wires, Wiring and Conduits.

Aluminum for Conductors.—Kershaw.—The conclusion of his article (Digest, Sept. 15). He gives some data on American electric power transmission lines with aluminum conductors, and also on some cases of practical application of aluminum for electric tramways and light railways transmission, for electric light cables, and for telegraph and telephone lines. He concludes that the resistance of aluminum to atmospheric influences is by no means so great as was at one time imagined, and that the proof is still lacking that an aluminum transmission line will possess the permanent efficiency of one constructed of copper. Reference is made to the fact that the Westinghouse Company, which had recommended aluminum for use on the Tacoma and Seattle line, when asked to specify for its use on the proposed power transmission scheme in Mysore, India, had replied that its use was too experimental to permit of this.—Lond. *Elec.,* Sept. 7.

REFERENCES.

Polyphase Circuits.—Blanc.—An article, illustrated by many diagrams, in which he develops a graphical method for determining the value of current and e. m. f. in interlinked polyphase systems.—*Elek. Zeit.,* Aug. 30, Sept. 6.

ELECTRO-PHYSICS AND MAGNETISM.

Ionization of Gases.—J. J. THOMSON.—A paper on the genesis of the ions in the discharge of electricity through gases. In some phenomena, such as the spark discharge and the ordinary discharge through vacuum tubes, there are no external sources available for the production of ions, so that these must in some way or another arise from the action of the field itself. He brings forward the view that the ionization is here produced by the motion through the gas of ions or corpuscles already present in the gas. These ions or corpuscles under the action of the electric field acquire velocity and kinetic energy; and when this velocity or energy reaches a definite value, which need not be the same for the positive as the negative ion, these ions or corpuscles are able, by their collision with the surrounding molecules, to produce other ions and corpuscles. This dissociation may be directly due to the collision or indirectly to rays like Röntgen rays produced by the collision. He takes the case of a gas through which a few ions are distributed; then, if the energy or velocity communicated by the electric field to these ions exceeds a certain critical value, each of the original ions will produce other ions, and these new ions will give rise to fresh ions, so that the number of ions and the conductivity of the gas will rapidly increase; it will go on increasing until the conductivity of the gas reaches such a value that the strength of the electric field is reduced so that the work done by it on an ion is equal to the critical value; when this stage is reached each ion produces one and only one successor, so that the number of ions remains constant, and the gas, with the discharge passing through it, attains a steady state. If the strength of the field had been so small that the work done on an ion was not equal to the critical value, the number of ions would not increase, and there would be no discharge through the gas beyond the very slight leak due to the ions originally present in the gas. Thus this view explains why a field of finite strength is required to send the discharge through a gas. He also shows how other phenomena may be easily explained by this view. Regarding the supposition that there is always a small number of ions present to start the discharge, he says that the experiments of Linss and of Elster and Geitel seem to show that such ions are present under ordinary conditions.—*Phil. Mag.*, September; Lond. *Elec.*, Sept. 7.

Ether.—LORD KELVIN.—Two papers on the theory of the ether. The first deals "with the motion produced in an infinite elastic solid by the motion through the space occupied by it of a body acting on it only by attraction or repulsion"; it suggests a conceivable explanation of the greatest difficulty hitherto presented by the undulatory theory of light; the motion of ponderable bodies through infinite space occupied by an elastic solid. The brief second paper deals with "the duties of ether for electricity and magnetism"; he suggests a hypothesis which "closely resembles Aepinus' doctrine of the middle of the eighteenth century, commonly referred to as the one-fluid theory of electricity; but now instead of electric fluid, we have ether, an elastic solid, pervading all space." Similar electric atoms repel one another, and dissimilar attract; in virtue of force between each atom and the portion of the ether within it, and mutual repulsion or attraction of these portions of ether with no contributive action of the ether in the space around them and between them. Stress in ether, being thus freed from the impossible task of transmitting both electrostatic and magnetic force, is quite competent to perform the simpler duty of transmitting magnetic force alone.—*Phil. Mag.*, August, September.

Spectroscopic Researches.—TROWBRIDGE.—An account of experiments from which he draws the following conclusions: When a condenser discharge is sent through a rarefied gas which is confined in a glass vessel, the gas can no longer be considered in the dry state, aqueous vapor being liberated from the glass; when a sufficiently powerful condenser discharge is used, dry hydrogen, dry nitrogen and rarefied air give substantially the same characteristic spectrum; when a very powerful, steady battery current is used to excite the tubes filled with these gases, various compounds of nitrogen and oxygen, nitrogen and hydrogen are formed if aluminum electrodes are employed. The four-line spectrum of hydrogen in the solar atmosphere is an evidence of aqueous vapor, and therefore of oxygen, in the sun. Conclusions in regard to the temperature of the stars, exhibiting hydrogen spectra, are misleading if based upon conditions of pressure and temperature in glass vessels; for conditions of electrical dissociation, of aqueous vapor, for instance, in the presence of an excess or lack of supply of oxygen, are the controlling ones rather than conditions of the mere pressure of the gas. X-ray phenomena, produced by a steady battery current, strongly suggest an electrical theory of the origin of the sun's corona.—*Phil. Mag.*, September.

Electrification by Ice.—EBERT AND HOFFMANN.—In experiments with liquid air they noticed that a body suspended above the surface of the liquid acquired a strong negative charge. A series of experiments showed that this charge is not due to the liquid air itself, but to the friction of minute particles of very cold ice suspended in it. This phenomenon may account for many errors and anomalies in experiments with liquid air, also for the strong electric effects of polar snowstorms, etc.—*Ann. der Physik*, No. 8; abstracted in Lond. *Elec.*, Sept. 7, and *Elek. Zeit.*, Sept. 6.

REFERENCES.

Ether.—LARMOR.—The first part of his presidential address to a section of the British Assoc. for the Advanc. of Sc., dealing with modern molecular theories and with the part which the ether plays in the modern view of the electric and magnetic phenomena.—Lond. *Elec.*, Sept. 7.

Electrons.—ORR.—A paper giving some "considerations regarding the theory of electrons," in the form developed by Larmor.—*Phil. Mag.*, September.

Masses Smaller Than Atoms.—ZEEMAN.—The first part of an address in which he gave a general summary of the researches of various investigators on this subject. This part deals mainly with cathode rays and the velocity and mass of the ions in cathode rays.—*Phys. Zeit.*, Sept. 8.

Electric Lines of Force.—ROBERTSON.—An illustrated description of a method for obtaining dust figures of electrostatic lines of force.—Lond. *Elec. Rev.*, Sept. 7.

Coherer.—MALAGOLI.—An account of experiments on the mode of working of the coherer, from which he concludes that Lodge's ideas respecting the mode of action of the electric waves upon powdered metals, which led him to choose the name "coherer," are completely in accordance with the facts.—*Il Nuovo Cim.*, 1899, p. 279; abstracted at some length in *Brit. Inst. Civ. Eng. Abstracts*, v. 141, Pt. 3.

Thermoelectricity.—MACLEAN.—The conclusion of his paper on the effects of strain on the thermoelectric qualities of metals (Digest, Sept. 22).—Lond. *Elec. Eng.*, Sept. 7.

Radium.—MADAME CURIE.—An account of experiments in which she has endeavored to isolate pure radium. The latest product contains only traces of barium. She found that the atomic weight of radium must be very high.—*Comptes Rendus*, Aug. 6; abstracted in Lond. *Elec.*, Sept. 7.

Spectrum of Radium.—RUNGE.—A paper in which he points out that the accuracy of Demarcay's determinations (Digest, Sept. 22) is not very great. He has redetermined the spectrum of radio-active barium chloride and has definitely located three of Demarcay's lines; they are not contained in the solar spectrum.—*Ann. der Physik*, No. 8; abstracted in Lond. *Elec.*, Sept. 7.

Roentgen Rays.—WINKELMANN.—An account of an investigation of the effect which a spark-gap has upon the production of Roentgen rays at higher pressures of the gas. The maximum pressure, at which rays are produced, depends upon the length of the spark-gap, upon its position, upon the nature of the gas, and upon the dimensions of the tube.—*Ann. der Physik*, v. 2, p. 757; abstracted in *Elek. Zeit.*, Sept. 6.

Becquerel Rays.—STEWART.—A long paper, giving a full résumé of our knowledge of Becquerel rays.—*Phys. Rev.*, September.

Wave Form of Alternating Currents.—BENISCHKE.—A reply to the communication of Richter (Digest, Sept. 22); he criticizes a formula given by Richter.—*Elek. Zeit.*, Sept. 6.

ELECTRO CHEMISTRY AND BATTERIES.

REFERENCES.

Production of Asymmetrical Alternating Currents by Means of Electrolytic Polarization.—HILDBURGH.—The first part of his paper in full, which was published in abstract in the ELEC. WORLD AND ENG., Apr. 14.—*School of Mines Quart.*, July.

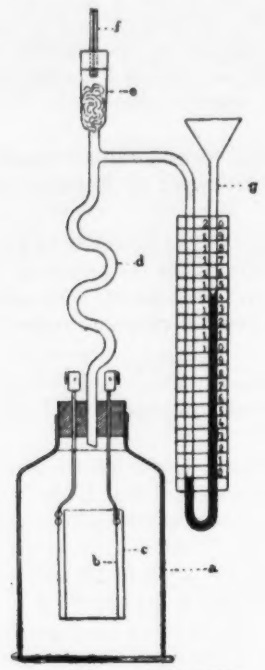
Aluminum.—HEROULT.—A paper on "Aluminum at a moderate price," read before the Internat. Congress of Mining and Metallurgy at Paris. He discusses the reactions which occur in the electrolytic production of aluminum.—*Eng. and Mining Jour.*, Sept. 15.

Dyeing and Printing Works.—SUNDERLAND.—A reprint of the English article on electro-chemistry in dye and print works, noticed in the Digest Sept. 22.—*El'ty*, Sept. 19.

UNITS, MEASUREMENTS AND INSTRUMENTS

Ampere Manometer.—BREDIG and HAHN.—An illustrated description of a simple method of using the gas voltameter as an ammeter.

If the ordinary gas voltameter is to be used for that purpose, two kinds of readings must be taken; readings of both the time and the gas volume, as it is desired to find the speed at which the gas is developed. They show that this speed can be found by a single measurement, if a manometer is combined with the gas voltameter. The amperes can be measured by the pressure shown at the manometer. They remark that on account of its simplicity and cheapness, their instrument is well adapted for many measurements in the laboratory, although it is not intended to be an instrument of preciseness. The glass tank *a* is nearly completely filled with lye of sodium (2 per cent), *b* and *c* are the two concentric cylindrical nickel electrodes which are separated from one another by some inserted glass rods. The gas which is developed by electrolysis, escapes through the glass tube *d* and enters the room *e*, where it is filtered by water, before it escapes through the capillary tube *f*, which has a convenient cross section; its length can easily be so chosen that the water manometer *g* indicates a difference of height in both arms of 1 cm, if the current is 1 amp. The sensibility of the instrument can be easily varied, so that, for instance, 1 amp. produces a difference of 10 cm in height of water in the arms of the manometer, by choosing another convenient capillary tube *f*. The instrument is convenient for analytical and synthetical electrolytic researches. The mistakes in the measurements of the current are not over 5 per cent.—*Phys. Zeit.*, Sept. 8.



AMPERE MANOMETER.

Meters for Three-Phase Currents.—STERN.—A communication referring to the paper of Moellinger (Digest, Aug. 18). He shows that the different formulas which are available for representing the power of a three-phase system with three conductors can be written in conformity as follows: the power is the sum of two products, each product consisting of two factors, one factor being a current, the other an e. m. f.; the sum of the angle between the phases of the two e. m. fs. and of the angle between the phases of the two currents is 180 degs.; the angle between the phases of the e. m. f. and the current of the first product is equal to the angle between the phases of the e. m. f. and the current of the second product.—*Elek. Zeit.*, Aug. 2.

Photometry of Incandescent Lamps.—SHARP.—A paper on an "Universal lamp-support for the photometry of incandescent lamps," describing the following method for determining the mean spherical intensity. The lamp is fixed to a vertical axis and is turned at the rate of four or five revolutions per second. The light sent out by the lamp in two directions, 180 degs. apart, is received by two sets of three mirrors, and, after triple reflection, is sent along the photometer bar. These mirrors are set between two rectangular frames which can be adjusted at any angular position on a horizontal axis, the prolongation of which passes through the mid-point of the lamp filament. When the lamp is rotating and the mirrors are set at a certain angle, one gets as a result of a photometer setting the sum of the mean intensities in two zones, corresponding to two directions 180 degs. apart. Therefore one needs only to make a sufficient number of measurements, with different positions of the mirrors, to get all the data required for the computation of the mean spherical intensity of the lamp.—*Phys. Rev.*, September.

Weston Cell.—KLEMENCIC.—An account of measurements of the internal resistance of the Weston cell, which is similar to the Clark cell, but in which cadmium is used instead of zinc and a solution of cadmium sulphate concentrated at 4 degs. without an excess of sulphate crystals. The temperature coefficient of the internal resistance is 0.025. He found that the internal resistance of cells supplied by the European Weston Elec. Inst. Co. was more constant than that of Weston and Clark cells, made after the rules of the German Reichsanstalt.—*Ann. der Physik*, v. 2, p. 848; abstracted in *Elek. Zeit.*, Sept. 6.

REFERENCES.

Hot Wire Instruments.—STEVENS.—A reply to the criticism of Lloyd (Digest, Sept. 15); he explains why he thinks that as a shunt ammeter the hot wire instrument is a distinct failure.—*Elec. Rev.*, Sept. 12.

Devices for Generating Alternating Current.—ERCOLINI.—A description of six simple devices for producing weak alternating currents for special experimental purposes.—*Il Nuovo Cim.*, October, 1899; abstracted at some length in *Brit. Inst. Civ. Eng. Abstracts*, v. 141, Pt. 3.

Wattmeter and Maximum Demand Indicator.—BARKER.—A paper read before the Brit. Assoc. for the Adv. of Sc., in which he describes a combination integrating wattmeter and maximum demand indicator.—Lond. *Elec.*, Sept. 7.

TELEGRAPHY TELEPHONY AND SIGNALS.

Simultaneous Telegraphy and Telephony.—TURPAIN.—An illustrated description of a device for using a telephone circuit for the transmission of simultaneous telegraphic messages, by employing wire waves generated by a Lecher oscillator. The main difficulty lies in protecting the telephone apparatus against the effect of the waves, which is done by enclosing it in a cabin papered with tinfoil. The line traverses a vacuum tube inserted in the wall and surrounded by a wire ring not in contact with it, but in touch with the tinfoil. The tinfoil is connected with the resonator; it captures the waves so that the telephone is not disturbed.—*Jour. de Physique*, August; abstracted in Lond. *Elec.*, Sept. 7.

Automatic Block Signal Failures Due to Lightning.—MILES.—A paper in abstract, read before the R'y Signalling Club at Atlantic City. There are two kinds of failures of automatic signals due to lightning: the failure of signals to clear and the consequent delay to traffic, and the failure of signals to go to danger and the consequent imperilling of train movements. The first problem has been solved by the introduction of the carbon contacts for relays and their use in combination with the fuse wires. To-day the problem is how to avoid the second evil, and the devices which must apparently be used to solve this problem are a lightning arrester which will take care of the heavy discharges without opening the circuit, combined with the use of carbon to prevent the fusing of relay contacts by so much of the lightning current as may pass through the arrester. He says that the fuse wire is the chief agency of the present woes, and gives a history of the steps taken by the Michigan Central R. R. to overcome the difficulties which they have encountered.—*Eng. News*, Sept.

New Book.

A HANDBOOK OF THE ELECTROMAGNETIC TELEGRAPH. By A. E. Loring. D. Van Nostrand Company. 116 pages. Price, 50 cents. Paper cover.

This is the fourth edition of a very handy and convenient little manual, which begins with an elementary discussion of electricity and magnetism, carries the reader as far as the quadruplex, and in its treatment of practical telegraphy ranges from the Morse alphabet to construction of pole lines. The new matter is that on the duplex and the quad, the apparatus and circuits for which are also shown.

American Electro-Therapeutic Association.

The tenth annual meeting of the above association began on Tuesday, Sept. 25, at the New York Academy of Medicine, 17 West Forty-third Street. An address of welcome was made by Mr. Randolph Guggenheimer, president of the Municipal Council. Dr. C. Dickson, of Toronto, and L. P. Bishop, on behalf of the Academy of Medicine, responded.

Tuesday morning's session was occupied by the presentation of reports of standing committees and by hearing two papers, one on "Galvanization," by Prof. A. Tripier, of France, and the other on "Electro-Therapeutic Sins," by Rev. H. Newman Lawrence, of Stapleton, N. Y. The afternoon session was devoted to a long discussion of the possible cure of consumption by electrical treatment of various kinds, among the speakers being Drs. M. J. Brooks, C. O. Files, Lefevre, Massey and Knopf. In the evening, Mr. E. W. Caldwell made some demonstrations with Roentgen ray apparatus intended especially for medico-surgical purposes. The convention will continue during the present week.

The Cable Ship Burnside Tested.

The United States steamship Burnside, which has been transformed from a transport to a cable ship, went on a short cruise outside of Sandy Hook on Sept. 24 in order to test her machinery. The Burnside will sail for Manila shortly, where she will take the place of the Hooker, which was wrecked on Corregidor Island, at the entrance of Manila Bay, a year ago. The Burnside will carry with her 500 knots of cable for the extension of the present cable system in the Philippines. Capt. G. O. Squier will be in charge of the work in the Philippines.

Pittsburg Meeting of the International Association of Municipal Electricians.

The fifth annual convention of the International Municipal Electricians was called to order in the banquet hall of the Monongahela Hotel, Pittsburg, Pa., Sept. 25, by the president, Capt. William Brophy, of Boston, Mass. He introduced the Rev. Dr. James, of Pittsburg, who invoked the Divine blessing. President Brophy then presented Mr. S. U. Trent, who welcomed the visitors to the Smoky City in the name of the municipality of Pittsburg. President Brophy responded in a fitting manner, thanking the representative of the city for the many invitations and courtesies extended. Mr. J. M. McGarey, police magistrate of the city, also welcomed the delegates.

President Brophy then read his annual address, in which he discussed in an admirable manner the many duties and responsibilities of municipal electrical officials.

Mr. M. W. Mead, of Pittsburg, chairman of the executive committee, made many announcements of entertainments.

Mr. M. J. Canfield, of Grand Rapids, Mich., was made temporary secretary.

Mr. J. P. Barrett, of Chicago, Ill., being introduced, made an interesting address, giving a brief history of the fire alarm and police telegraphs of America.

After the roll-call was finished, Mr. F. C. Mason, of Brooklyn, N. Y., moved an amendment to the constitution increasing the number of members of the executive committee to nine instead of five, and the adding a first, second and third vice-president to the list of officers, so that all sections of the country can be represented on the board.

New members were elected as follows: R. E. Moran, of Memphis, Tenn.; M. J. Donohue, of Niagara Falls, N. Y.; A. C. Farrand, of Atlantic City, N. J.; H. C. Fanald, of Lowell, Mass.; L. M. Tillotson, of Yonkers, N. Y. All these new members are city electricians.

At the afternoon session, Mr. George F. Macdonald took the chair while President Brophy read his paper on the benefits to be derived from the association.

Capt. Brophy's paper was fully discussed and during the discussion the Pittsburg manual or code of laws, ordinances and regulations relating to the Bureau of Electricity and the erection, construction and inspection of wires, etc., was brought to notice. This admirable manual is due to Mr. Morris Mead, of that city.

Other papers were on the programme, to be presented by Mr. F. C. Mason on "Contact Points," by Mr. G. Canfield on "Trials and Troubles of Instituting and Enforcing Municipal Inspection and Control," by Mr. C. Burger on "Automatic Fire Alarm Systems," by Mr. C. T. Clark on "The Responsibility of the Individual in Municipal Electrical Engineering," and by Mr. Francis W. Jones on "The Advantages and Disadvantages of Carrying High and Low Potential Conductors on the Same Poles."

A number of excursions and entertainments were laid out, including a trip on the steamer "Mayflower" and a special fireworks display at Schenley Park by the Consolidated Traction Company. The delegates were also invited to visit all the Westinghouse electrical manufacturing enterprises that centre in Pittsburg.

The display of exhibits relating to the electrical industry was, as usual, quite large and complete. The convention was in full swing when this report was dispatched.

NOTES.

J. JONES & SONS, of New York, were represented by Mr. James Jones.

HOLMES ELECTRIC PROTECTION COMPANY was represented by Mr. C. B. McFrail.

THE GORDON BATTERY COMPANY was represented by Mr. W. C. Banks, of New York.

MR. F. M. FERRIN, of 7 Arch Street, Boston, showed samples of woven covered cables.

MR. FREDERICK PEARCE, successor to Pearce & Jones, manufacturing electricians, was in attendance.

MR. JOHN T. MCROY looked after the interests of vitrified clay conduits made under the McRoy patents.

MR. WM. C. CALLMANN was in charge of the exhibit of the Baines Improved Primary Battery Company. He showed and explained its batteries.

THE GAMEWELL FIRE ALARM COMPANY, of New York, was represented by Mr. M. Kiernan, of New York, and Mr. E. B. Chandler, of Chicago.

THE BUNNELL TELEGRAPHIC AND ELECTRICAL COMPANY, of New York, manufacturer of telegraph instruments and supplies, was well represented by Mr. De Witt C. Bunnell.

MR. W. S. LOGUE represented the Edison Manufacturing Company, of New York and Orange, N. J., makers of the Edison-Lalande batteries for fire alarm, telephone, railway signals and all municipal work.

ROCHESTER ELECTRICAL MANUFACTURING COMPANY, Rochester, N. Y., was represented by Mr. Louis W. Miller, who is also city electrician of Rochester. It manufactures the Miller cut-out, for the protection of fire alarm and police telegraph boxes. It is endorsed by the National Board of Underwriters.

MR. GEO. T. MANSON, general superintendent of the Okonite Company, of New York, represented his company, and showed samples of its well-known products, and distributed souvenirs consisting of cigar ash receivers, which were greatly in demand. The Okonite Company also had a novelty in the way of various colored feathers attached to burrs, which stuck to clothing in a funny way. The feathers bore an appropriate motto: "Stick to Okonite."

MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, was represented by Mr. F. S. Palmer, who had a number of drawings showing fire alarm wires for houses connected with the door-bell service; multiphase fire-detecting wire, associated with watchman's register in connection with thermostats and manual alarm boxes, reels of multiphase fire-detecting wire, the multiphase fire-detecting wire paralleling electric light apparatus such as switchboards, branch boxes, etc.

THE SPRAGUE ELECTRIC COMPANY, of New York, was represented by Mr. Alexander Henderson, who had an exhibit of the Greenfield flexible steel conduit and steel flexible armored conductors, together with junction and outlet boxes of the latest pattern, and also their new type "N" outlet plate. The Sprague Company's exhibit also comprised a complete line of their flexible goods and fittings, including steel armored flexible pendants, terminal rosettes, bushings and couplings. They also showed for the first time samples of their enameled flexible conduit, which stands a very severe test for hardness of finish.

STANDARD UNDERGROUND CABLE COMPANY had an exhibit in Parlor No. 7 of the Monongahela House. It consisted of samples of its electric wires and cables, including its rubber insulated, fibre insulated and paper insulated cables, for aerial, underground and submarine use, and its many forms of electric wires for all classes of service. In addition to these, it exhibited also many wire and cable accessories, such as terminal heads, lightning arresters, etc. All the above-named samples were carefully arranged in four large exhibition cabinets of black walnut, backed with bird's-eye maple. The company was represented by Mr. P. H. W. Smith, assistant general manager; Mr. F. A. Rinehart, treasurer; Mr. F. C. Cosby, assistant manager sales department; Mr. F. S. Viele, general superintendent of construction; S. E. Stearns, assistant superintendent of construction, and Mr. George L. Wiley, Eastern manager.

Meeting of Old-Time Telegraphers and the Military Telegraph Corps.

The Old-Time Telegraphers' Association held its annual meeting in St. Paul, Minn., on Sept. 18. Montreal was chosen for the next place of meeting. The following officers were elected: President, L. B. MacFarlane, superintendent Bell Telephone Company of Canada; vice-president, J. E. Hutchinson, superintendent of the Ottawa Electric Railway; secretary-treasurer, John Brant, of New York.

Following immediately after the Old-Timers came the meeting of the United States Military Telegraph Corps. Resolutions were adopted protesting against the exclusion of the telegraphers who saw

hard service in the Civil War from the benefits of the pension laws. Officers were elected as follows: President, Col. W. B. Wilson, of Philadelphia; vice-president, William L. Ives, of New York; secretary-treasurer, J. E. Pettit, of Chicago.

Automobile Races and Exhibitions.

With the coming of the fall season, automobile races and exhibitions are conspicuous events, and within the past week no fewer than three important affairs of this nature have taken place, one at Guttenburg Tri-State Fair, New Jersey; one at the great Trenton, N. J., Interstate Fair, and one at Chicago. The Guttenburg races and exhibit attracted some 5000 people. There were in all seven races, a brake manipulating test, an obstacle race, and prizes for the best looking or best decorated vehicles. Mr. A. L. Riker was entered in the 10-mile race with his famous automobile that established the

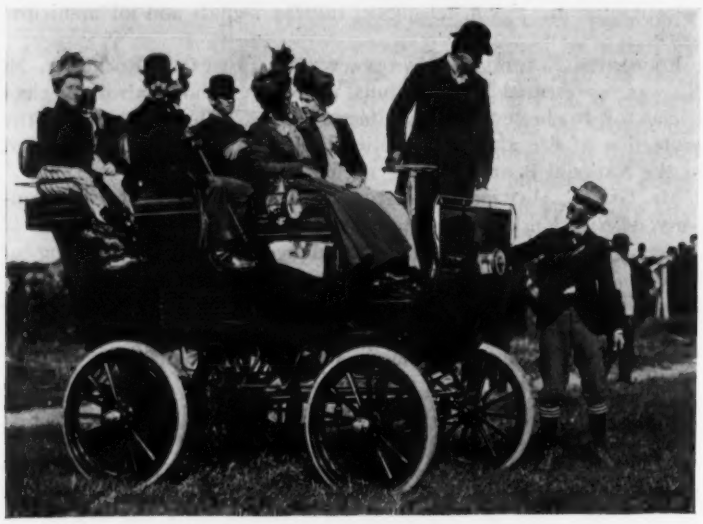


FIG. 1.—ELECTRIC BRAKE AT GUTTENBURG, N. J.

American road record for 50 miles, but some mishap occurred to it in the first mile and threw him out of the contest. In the one-mile for electrics Mr. Riker had a walkover, to qualify for the championship race, and the time made was 3:16 1-5. We illustrate herewith the electric brake driven by Mr. R. M. Barwise, who got the prize with it for the best-appearing vehicle; and we show also the decorated electric Stanhope, guided by Miss Eva Mudge.

The opening day of the Greater Interstate Fair at Trenton, N. J., was ushered in with automobile races. The card contained six contests, and prizes were offered for the different types of electric, gasoline and steam. The several races were well contested and the interest and enthusiasm felt by the thousands of spectators shows how rapidly automobiling is taking hold of the people.

In the building specially set aside for the exhibition of automobiles are shown many various styles of carriages of different motive power, including some 20 vehicles in all. The largest electric exhibit was that of the American Bicycle Company, whose representative, Mr. Bennett, had a half-dozen different types under his care. So far as the races are concerned, there were none in which electrics participated, but Mr. C. J. Field showed up very well with his De Dion-Bouton motorettes.

In spite of the fact that the automobile exhibition business is being somewhat overdone in the East, the exhibition and race meet promoted by the *Inter Ocean* at Chicago, and held last week and this week, was welcomed by both exhibitors and public as the first opportunity offered in the West for the advancement of automobile interests in this way. The exhibition attracted visitors from all over the Central States and did much to help automobile introduction in that territory. The show was announced to open Tuesday, Sept. 18, but, as is usual at such places, the opening morning found the exhibition quarters in a rather chaotic condition. It was not until the second day that the show took on a finished appearance. The place selected for the meet—the Washington Park club grounds—is ideal for the purpose. The open space with concreted floor under the grand stand was used for an exhibition hall, and vehicles could be easily run in and out onto the surrounding driveways and race track for exhibition and trial runs. The meeting was to have ended last Saturday, but owing to bad weather one day and the great number of racing and other contests booked, the show was continued into this week, Monday and Tuesday. The electric vehicles were decidedly in the lead in numbers, though they were comparatively unobtrusive as compared with the noisy gasoline racers that were a conspicuous feature of the meet. To any one familiar with inside information, the exhibition brought out the fact that though there are a few companies fairly launched in the electric vehicle manufacturing business, the majority are in a formative condition, and even those having large, established factories in full operation have much money to invest yet in putting the business on a satisfactory working basis and perfecting arrangements for the proper care of vehicles sold in different localities, so that guarantees made on maintenance can be successfully carried out. However, in the case of the stronger companies, such arrangements are being rapidly made.

The racing contests were in the main well classified so as to bring together vehicles of similar capacity. However, the electric vehicle manufacturers, as a rule, have preferred to give their attention to the perfection of machines for commercial use rather than to racing machines. Mr. Chas. Lindstrom, of the Hewitt-Lindstrom Motor Company, of Chicago, turned out with a road wagon weighing 1850 pounds and carrying two 2½-hp motors with heavy battery, and he captured the prize for electric vehicles, one mile, flying start, in 2:34, with a rather soft track and heavy wind on the home stretch. Mr. Lindstrom claims to have made a mile in 1:58 on macadam road with a less consumption of energy than during the race just mentioned. Further details of this vehicle will be given in a later issue. No one contested for this event against Mr. Lindstrom. Mr. Lindstrom's 13-year-old daughter won the two-mile ladies' race with the same vehicle, and it took second in the five-mile race open to members of the Chicago Automobile Club, in which all classes of motive power were allowed.

The contests other than for speed were some of them easy marks for the electric vehicle. In the automobile parade for manufacturers, the gold medal for the largest number of vehicles in line, and the gold medal for the greatest number of practical designs in line, both went to the Hewitt-Lindstrom Motor Company. The medal for the most

FIG. 2.—DECORATED ELECTRIC STANHOPE, GUTTENBURG, N. J.

practical design was taken by the Woods Motor Vehicle Company, of Chicago. The latter company had by far the largest number of vehicles on exhibition, but owing to delay in obtaining charging current at the grounds, could not put out all of its vehicles at the time of the parade. In the parade for private owners, J. Wesley Allison, vice-president of the Woods Motor Vehicle Company, took the prize for the most elegant turnout; and the prize for the automobile carrying the greatest number of seated passengers was awarded to Charles A. Lindstrom, with a bus seating 22 persons.

The largest exhibit at the show was made by the Woods Motor Vehicle Company, of Chicago, which brought down 21 vehicles of different kinds from its Wabash Avenue factory and salesroom. The exhibit was in charge of Bruce Clark, with R. B. Leffingwell as assistant. The exhibit consisted of a landau, an extension brougham,

a single brougham, a hansom cab, four delivery wagons of different styles, three top runabouts, a spindle seat, two stanhopes, a brake, a physician's coupé, a brougham cab, a station wagon and two victorias. Forty cells of battery are used in all of these vehicles except in the runabouts, which have 36. A 45-ampere hour battery is used on the runabouts. The latter weigh 1000 pounds each. On the hansom cabs and extension broughams, which weigh 2800 and 3000 pounds, the battery used is rated at 120 ampere hours, weighing 1200 pounds, and that on the other vehicles, which weigh on an average about 2400 pounds, is called a 100-ampere hour battery. Helios-Upton and Willard batteries are used.

Next in order, both in location and size, came the Waverly electric carriages exhibited by the Waverly factory of the American Bicycle Company, Indianapolis. J. S. Conwell, general manager of the factory handled the corps of representatives, ably seconded by Walter L. Githins, general sales agent. Herbert A. Githins, Cleveland agent, Geo. A. Duncan, Minneapolis agent, and Fred Patee, of Peoria, were also present. Seven electric vehicles of neat design were shown—a road wagon, a runabout, a trap, a park phæton, a stanhope, a road wagon with top, and a runabout with top. One noticeable feature of the Waverly vehicles is the substantial mechanical design as to running gear. All these vehicles have single motors and differential gears on the armature shaft, which is hollow. Helios-Upton, Willard and Waverly batteries are used. The latter is a pasted plate of great mileage capacity and short life, but cheaply replacable. The company makes a maintenance guarantee covering cost of battery repairs.

The Hewitt-Lindstrom Company, of Chicago, had a handsome exhibit of five vehicles, a bus, a delivery wagon, a brake, a stanhope and a runabout. Chas. Lindstrom, engineer, and R. J. Randolph, with a corps of assistants, called the attention of visitors to the high efficiency of motors and batteries used on these carriages. Mr. Lindstrom stated that his new design of battery was on the vehicles exhibited and claimed a high capacity for it. The vehicles making up this exhibit will be described more in detail in another issue.

The Olds Motor Works, Detroit, had a fine stanhope on the floor which attracted much attention for its neatness of motor and running gear appearance. All gearing is inclosed in a symmetrical phosphor bronze casing. Both front and rear springs are coach springs. R. E. Olds, manager, and M. F. Loomis were present. Willard batteries are used by this concern.

The Helios-Upton Company, Chicago factory, was well represented, both by batteries on automobiles of various makers and by officers of the company. William Hood, general sales agent, was found in charge of the exhibit. Mr. King Upton, managing director of the company; R. C. Gregg, Western manager, and Thomas Spencer, general superintendent, were present. The storage battery factory of this company, in Chicago, is so crowded with orders that it was with difficulty the company could put off its customers long enough to exhibit the two sets of batteries it showed.

The new firm of Strong & Rogers, Cleveland, was represented by an elegant stanhope and by Mr. Rogers himself. Mr. Rogers, of Brush Electric Company fame, was kept exceedingly busy showing this carriage, which is of the single motor type, having the differential gear inside the large gear wheel.

The Porter Battery Company, Chicago, which is now actively engaged in manufacturing automobile batteries, had an exhibit of batteries, looked after by H. C. Porter, superintendent and inventor. In this battery the active material is pasted into a slotted grid. Lead terminals permitting easy disconnection of the cells are a feature of this battery. Mr. Porter had a Woods runabout on the grounds equipped with his batteries.

The "Autosparker," which is attracting much favorable attention among gasoline automobile makers, and is made by the Motsinger Device Manufacturing Company, was shown, not only by that company, but in operation on the St. Louis Motor Carriage Company's carriages, notably on one which John L. French, president of the latter company, rode from St. Louis to Chicago just before the meet. He carried no batteries—none of the St. Louis carriages have ignition batteries, as the autosparker has done away with that necessity—and had no trouble whatever with ignition the whole distance. The autosparker dynamo runs at a constant speed, whatever the speed of the engine, and, working through an Edison-Lelande coil for touch spark, gives 10 volts 3 amperes; working through a Splitdorf coil for a jump spark it gives as high as a 2-in. spark. N. H. Motsinger, president, and R. A. Morris, secretary, represented the company.

The Wagner Electric Manufacturing Company, St. Louis, of which Geo. B. Foster is Chicago agent, had a very useful but unobtrusive exhibit in the form of a motor generator set for converting the 60-cycle 2000-volt alternating current available at the grounds into 110-volt current for charging. A 20-hp single-phase 200-volt generator was coupled to a 64-ampere 125-volt generator running 1200 r. p. m. The set ran without noise or spark. The accompanying switchboard had Wagner direct-current ammeter and voltmeter.

A Milwaukee Electric Company 110 to 125-volt motor generator set was running in the booth of the Hewitt-Lindstrom Motor Company to furnish the special high voltage used on the Lindstrom vehicles.

The meet has not closed at present writing and more notes regarding it will appear in these pages next week.

Automobile Work in Cleveland.

Lately there has been a tendency on the part of electric automobile manufacturers to experiment with a view to producing a more compact and lighter machine. Among workers in this direction has been the Baker Motor Vehicle Company, of Cleveland, at the head of which is Mr. Walter Baker, who has been interested in electric vehicle work for a number of years, and who is well known to the carriage and automobile trades through the Baker ball bearing. It has been Mr. Baker's theory that by first materially reducing the size and weight of the battery and using a correspondingly light motor and running gear, the weight of the vehicle could be so reduced that the quantity of current drawn from the batteries would be but a small fraction of that required to propel a heavier vehicle. A number of these vehicles have been built for trial, and after numerous changes, a standard has been adopted. Aside from the feature of reduced weight, it has been the aim of the company to produce a carriage which should be so simple that a mere novice could use it with but little instruction; also to produce a carriage which should be safe in the hands of a woman. With this point in view, the vehicle can be furnished with a low phaeton body instead of the piano box body.

The weight of the vehicle complete in either style is less than 500 lbs. The batteries weigh 186 lbs., and while their radius of action is not so great as in a vehicle of several times that weight, yet 30 miles with one charge has been made repeatedly, and a radius of 20 miles over ordinary roads is guaranteed. The battery consists of 10 cells of 45 amp.-hours each. The motor is of special design, exerting three-quarter horse-power under normal load and capable of heavy overload. Numerous hill climbing tests have shown it capable of considerable torque; 20 per cent grades have been made frequently without difficulty. The motor and speeds are prepared according to the character of the work required of the vehicle. Where a fairly high speed is desired, a compound-wound motor is used, so that by pressing a foot button, a shunt is opened and a maximum speed obtained. Ordinarily there are two speeds, drawing 10 and 20 volts from the battery. There is but one speed-controlling handle, which also operates a powerful band brake on the motor shaft. Ordinarily this is sufficient to stop the carriage in its own length when traveling at full speed. There is also an auxiliary brake operating on the rear axle at the differential, which is controlled by a foot lever. The motor is suspended from the body of the vehicle, slightly forward of the centre, and it is entirely covered by a wooden case, which is easily removable, and so attached that it will not rattle. The chain is from the motor shaft to the centre of the rear axle; the rear sprocket is contained in an arched frame and is combined with the differential. Chain adjustment is effected by an adjustable rod which slightly moves the motor backward or forward. The frame is very strong, yet flexible, being made of steel tubing with hickory side bars. The body and all parts are carried by springs, making the carriage extremely easy riding. The hubs and spokes are of a composition metal which will not rust or tarnish, and which is said to be tougher than steel, thus overcoming, it is claimed, the greatest objection to the wire wheel. Any style of high grade pneumatic tires is furnished, the wheels being 28 ins. in diameter. The vehicle is furnished with an incandescent headlight and electric push button bell. A standard Weston combined volt and ammeter is furnished, and the vehicle will not be furnished without this indicator. In general appearance this vehicle resembles closely an ordinary piano box carriage of small size. The batteries are wholly under the seat, so that the rear of the box is open, as in an ordinary vehicle.

For charging the batteries, the Baker Company advocates, and will furnish, the automatic gas engine plant manufactured by J. B. Merriam, of Cleveland.

The Baker Company will have an exhibit at the New York automobile exhibition.

The charging plant illustrated herewith is claimed by its designer, J. B. Merriam, Century Building, Cleveland, to answer all the requirements. It is composed of a four-cycle gas engine, direct connected by shaft to a generator of one-half kilowatt capacity; incidentally, it is thought that this is the smallest direct connected gas engine plant made. A switchboard of well-known type is used, and through this the action of the plant is entirely automatic, as it is only necessary to insert a plug in the vehicle and turn a switch. When the batteries are filled a switch drops automatically and the machines stop. Several novel features in gas-engine construction are shown in this plant. For instance, the usual method of starting the gas engine by turning a crank is dispensed with. Months of practical work have shown that the amount of electrical energy remaining in the batteries after a run is always sufficient to start the electrical machine as a motor, thus giving the necessary starting impulse to the engine. The usual batteries for sparking purposes are also dispensed with in connection with the engine; the current for sparking being taken directly from the field windings of the unit; the system working perfectly whether the machine is running as a motor or a generator. In the illustration a wire will be seen leading from the binding post of the dynamo to the spark coil above; the circuit being completed by a connecting link from the dynamo fields to the body of the gas engine. A primary make-and-break spark is used, and asbestos washers are used for insulation on the spark plug. The engine has a speed of 1800 r. p. m., and when properly handled it is claimed it never misses a charge. The plant illustrated uses coal gas, the mixture being regulated by a stop cock. When the batteries are filled, the switch drops, at the same time turning a second cock on the fuel supply of the engine, thus stopping both machines. In case of any break in the connections or accident to the generator, the engine is instantly stopped by the same method. When coal gas is not obtainable, gasoline may be substituted, and a carburetter working on a well-known principle may be applied to the engine without change. In the plant illustrated, a constant stream of city water passes through the water jacket around the cylinder of the engine and out through the exhaust pipe and muffler. In a convenient manner the exhaust pipe leads outside of the building and into the eaves pipe, so that there is not the slightest noise or indication of the exhaust. If necessary, a stationary supply of water may be utilized for cooling purposes. The engine is well built and designed for simplicity. All valves may be easily removed for cleaning or adjusting. The secondary gear and main bearings are of hardened phosphor bronze and may be easily removed. No oil cups are used, the cylinder, main bearing and connecting rod are all oiled from the crank chamber, which requires but little care. An advantageous feature of the plant is that it occupies but little space; the base being less than 2 ft. wide and the height at the highest point of the engine is 27 ins. The total weight is about 300 lbs.

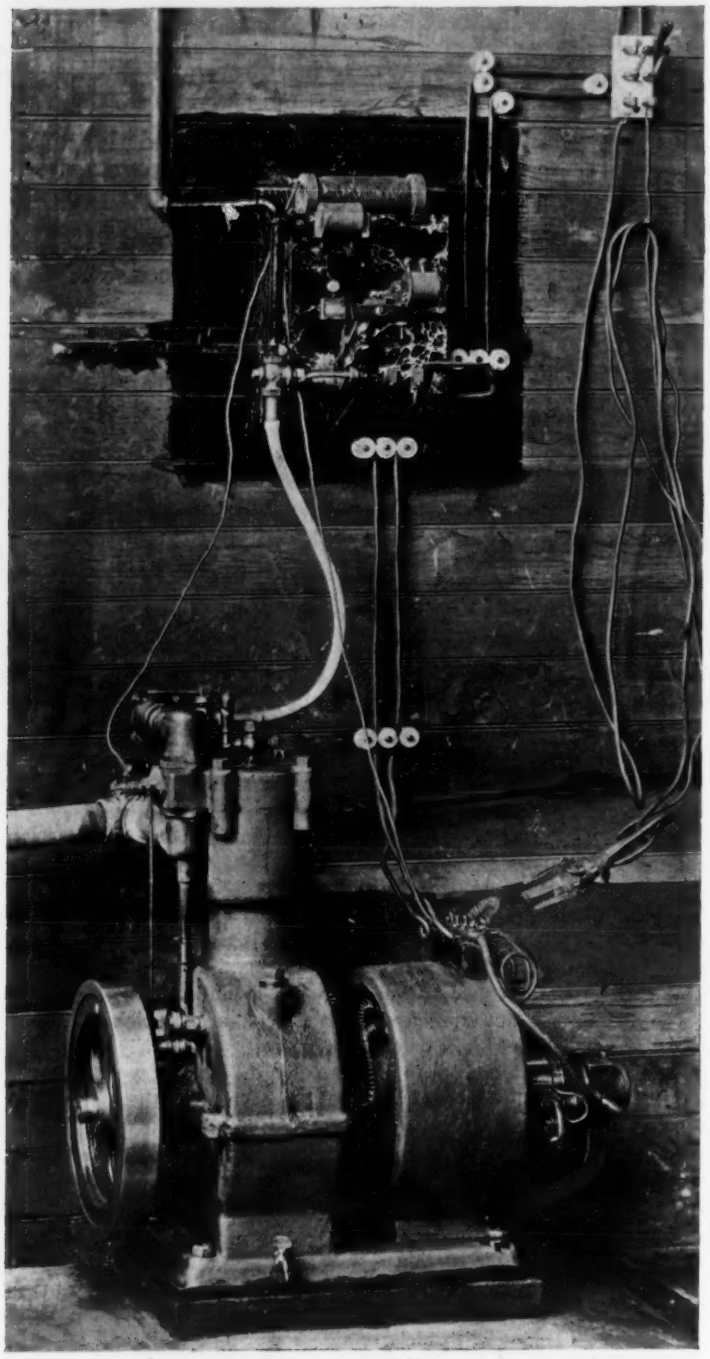


FIG. 1.—CHARGING PLANT FOR ELECTRIC VEHICLES.

FIG. 2.—LIGHT-WEIGHT ELECTRIC AUTOMOBILE.

A New Telephone Fire Alarm System.

L. D. & E. D. Tillyer, of Dover, N. J., have been granted a U. S. patent on a new fire alarm system known as the Tillyer electro-mechanical bell striker and telephone fire alarm, in which the cost of installation is said to have been cut in two, while an improved service is rendered. The cost of maintenance is slight, as the whole system is operated by magneto current and dry batteries.

After the system is installed and the striker, switchboard drops, etc., are properly placed and adjusted, there is absolutely nothing to get out of order except the burning out of a fuse once in a while by lightning or sneak current, and these can easily be replaced by any man or boy at a cost of about two cents each. No expert is needed to watch delicate and expensive instruments and keep them in repair.

Instead of encircling a town with a single wire which, if it becomes broken or cut, leaves the whole town without a fire alarm system until repairs are made, a separate wire is used for each district, but any number of telephones may be connected with any district wire; in fact, every house or factory along that street or in that district can be connected with the fire alarm systems at a trifling cost to each, and at a still less cost each long-distance telephone can be connected with the system by using a special three-pole double-contact key.

This system can also be used for police or ambulance call, etc., by giving the telephone or magneto handle a short sudden pull or turn, when it will throw the drop (which is numbered to correspond with that district) on the switchboard and start the small bell ringing without ringing the tower bell, thus calling the janitor, or whoever may be in attendance, when the wants of those "calling up" may be made known.

At each district box the line is fused and the instrument protected by ground wire. The line is grounded by an automatic switch arrangement before it reaches the fuse at all times, except when the door of the box is opened to turn in an alarm. The opening and closing of the door operates the switch. In case the telephone is placed, without the iron box, in a building, a spring hand switch is used. At the sub-station the wires are automatically short-circuited before the fuses and telephone are reached; thus the current or lightning passes on to its destination. This short-circuit is broken by the opening of the door to turn in an alarm. Each district line is connected with a double fuse on the switchboard by a two-point switch, and if lightning passes over the line wire and burns out one fuse the fact is indicated by the drop of that line and the ringing of the small bell without striking the tower bell. The attendant simply switches in the next fuse and replaces the one burned out, so that the line is in circuit even while the old fuse is being replaced. There is a ground plate beneath each fuse to conduct the lightning to the ground when the fuse is burned out and the line becomes overcharged. The tower bell and all the instruments are thus protected from damage.

When an alarm is turned in, the tower bell will continue to ring, giving a general alarm, as long as the party sending in the alarm turns the handle of the telephone or until shut off by the attendant of the central station, who will then strike the number indicated by the drop. This is done by the simple manipulation of a double contact key; any one can do it after being once shown how.

Each district line can be tested as often as required by the attendant at the engine house, where the central is supposed to be located, by a simple switch arrangement without ringing the tower bell, as can also each drop on the switchboard. This striker can be connected up to ring several tower or church bells simultaneously, and also blow steam whistles. Of course, there must be a separate striker for each bell or whistle, but all can be operated at the same time and from the same telephone or with the same key. When an alarm is turned in the exact location can be told over the telephone in addition to throwing the drop indicating the district, and during the progress of the fire the chief or other man in authority can telephone in for more apparatus or help, or state his other wants, or give orders to strike "back taps." The inventors have, we understand, filed applications for patents in Canada, England, France, Belgium and Sweden.

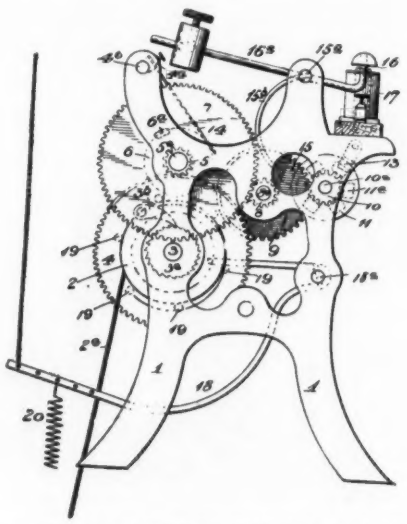


FIG. 1.—SIDE ELEVATION OF STRIKING MECHANISM.

Fig. 1 is a side elevation of the striking machanism referred to. Fig. 2 is a diagrammatic view showing the arrangement of the circuit wires, switches, etc. It shows a single drop with the lightning arrester placed in the rear of the magnet, and not above, as shown on complete switchboard illustrated in Fig. 3. This is done to more fully illustrate the fuses and switch arrangement. It will also be seen that the wires, keys, bell, buzzer, etc., are differently arranged for the purpose of illustration, and that an ordinary wall telephone is used for the same purpose, instead of a desk telephone, as shown in Fig. 3. In showing the district telephone and the intermediate telephone, an ordinary wall instrument is used with the switches above. In actual use, however, the district telephones are inclosed in an iron box, and the telephones are automatically switched in and out of circuit by the opening and closing of the door.

Fig. 3 shows a complete switchboard with the battery box beneath

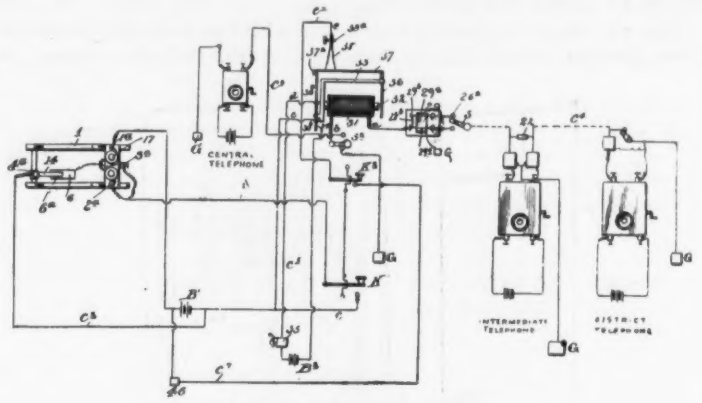


FIG. 2.—DIAGRAM OF CIRCUITS.

the shelf. The top row of switches (1) is to throw the district line from one lightning arrester or fuse (they are in pairs) to the other, thus keeping the line in circuit while one fuse in case of burn-out is being replaced; (3) shows clamps holding the fuses so that they can be slipped in and out in an instant; (2) a brass plate, behind the fuses, to which the lightning would jump and pass off over the attached ground wire instead of through and burning out the instruments; (4) a double contact testing key to test each drop and line wire; (5) double contact key which is used to strike the district and tower bell; (6) numbered drop, or combination relay and drop, indicating the district; (7) switches used in testing line wire or to converse with any district telephone; (8) central station telephone; (9) small bell to call the attention of the janitor when a police or ambulance call is turned in, or fuses are burned out by lightning; this bell, when started, will ring until janitor replaces drop; (10) buzzer used in testing drops and line wires; (11) magneto to call up when telephones are placed in separate engine or hose houses, and also used in testing lines; (12) relay used in combination with combination relay and drop. When the drop is released on the turning in of an

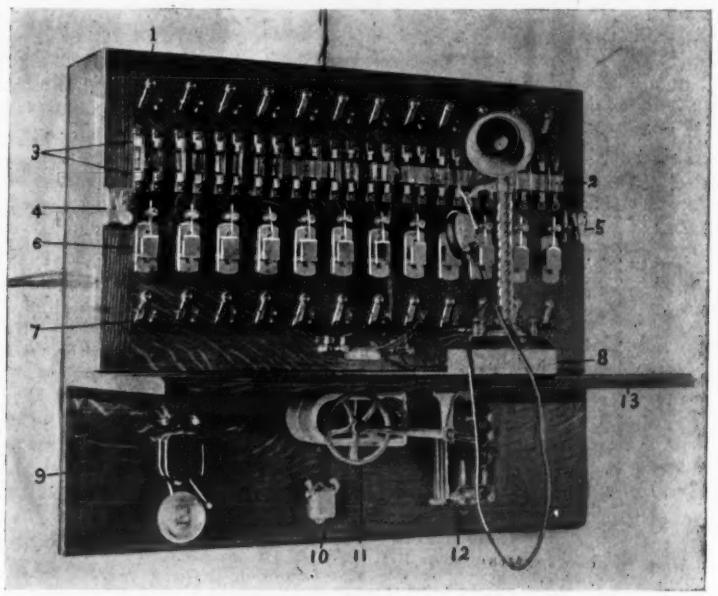


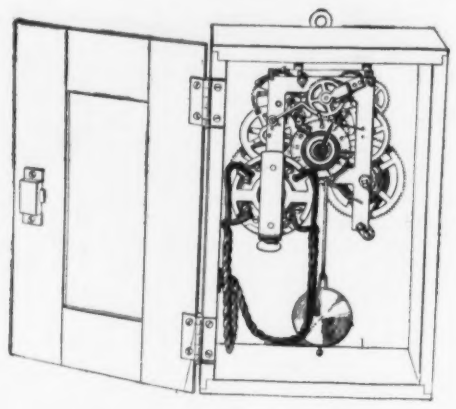
FIG. 3.—SWITCHBOARD.

alarm, the tongue, which releases the drop, is raised, the platinum contact acting as a relay conveying a battery current to a secondary relay, under the shelf, which controls the battery current opening the release magnets on the striker, and thus the tower bell continues to strike, giving a general alarm as long as the handle of the magneto of the district telephone is being turned by the party sending in an alarm. The janitor, however, can stop the general alarm at any time and strike the district with the double contact key 5.

Electric Time Switch.

The apparatus illustrated herewith, the Miller electric time switch, is for use in places where it is desired to turn lights on and off at any set time. It is so constructed that it insures positive working at all times, and will run ten days on one winding. There is no complicated mechanism in it to become deranged, and it is not affected by magnetism or change of temperature.

This switch can be used in connection with two ordinary meters so as to give the same results as obtained from the two-rate meters. It

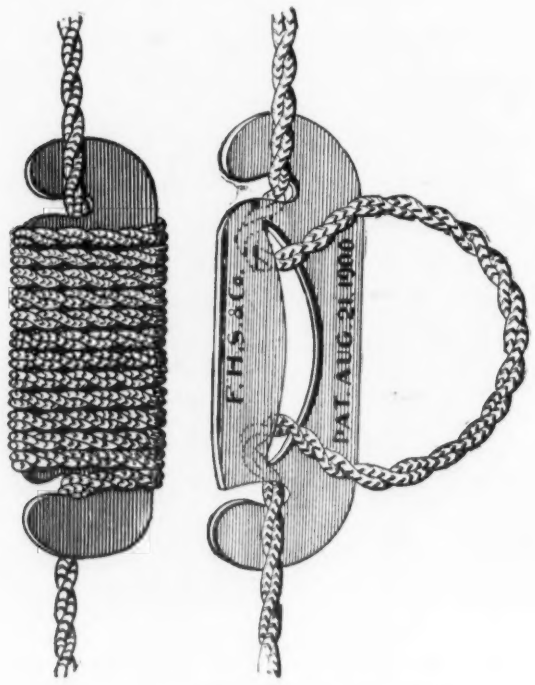


VIEW OF TIME SWITCH MECHANISM.

can be used with low potential arc lamps as well as incandescent lamps, and at the time set to turn off the lights the switch operates automatically. Contract lighting for stores, show windows, signs, club rooms, apartment houses, etc., it is stated, can be made profitable by the use of this switch, which is made by S. B. Condit, Jr., & Company, Boston, Mass.

Stewart Lamp Cord Adjuster.

The two accompanying illustrations show a new lamp cord adjuster recently patented and brought out by Frank H. Stewart & Company, Philadelphia, Pa. The feature of this adjuster is that it will take and hold any size of cord. As will be noticed, the slot is converging at both ends, so that a cord of any size may be securely

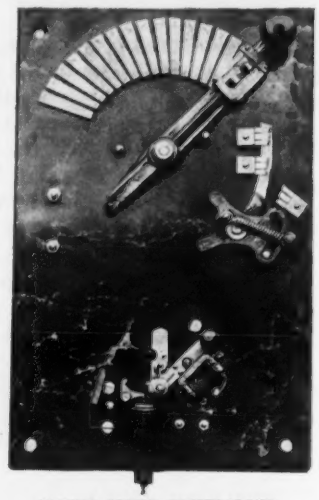


FIGS. 1 AND 2.—LAMP CORD ADJUSTER.

wedged and locked by means of the throat at each end. The adjuster can be applied to the cord of a lamp already suspended, thus avoiding the necessity and annoyance of disconnecting the cord. It is a very simple device and is made of fibre. The illustrations show the method of adjustment.

Printing Press Motor Speed Controller.

The apparatus shown in the accompanying illustration is designed to control the speed of motors used in driving printing presses, or performing similar heavy duty, in which the motor is to be started under heavy torque at various reduced speeds.



MOTOR SPEED CONTROLLER.

The circuit is opened and closed by an independent, inter-locking, double-acting snap switch, provided with hammer-blow feature. By this make-and-break switch, the burning of the contacts is almost entirely eliminated, making the controller especially adapted for continually starting and stopping the motor under conditions of full load. The switch contact parts are of very large surface for the current they are designed to carry, and every part is easily removable from the face of the switch.

This controller, which is manufactured by the Ward Leonard Electric Company, Bronxville, N. Y., is also provided with that company's "D. K." type circuit breaker adjusted for opening at overload, and also at failure of current on the line.

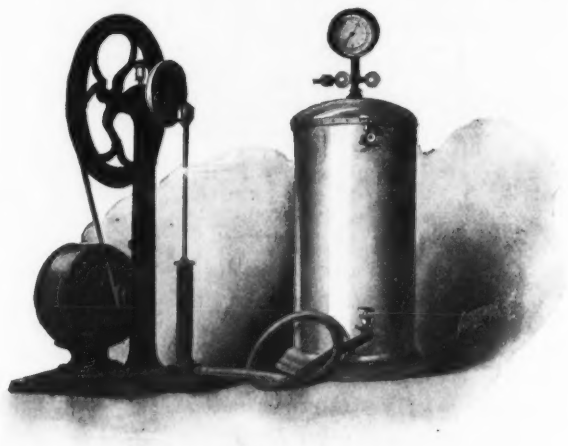
A pair of binding terminals are provided for running the circuit around the press for short circuiting the field (holding) magnet, by push buttons, thus opening the circuit in case it is desired to stop the press from some distant point.

Electrically Driven Air Pump.

A special application of the Emerson alternating current motor is shown in the accompanying illustration, which represents a dental and surgical air pump outfit. The outfit consists of a single-action piston air pump, operated by an Emerson motor of the E. I. 2 or F. I. 2 types.

This style of outfit is not only much more convenient than any water pressure air pump, but in most cases will cost very much less to operate, and has the additional great advantage of being able to get the pressure anywhere that it is desirable. No permanent fixtures are necessary for fitting up this outfit. All that is needed to start it in operation is to plug in the lamp socket the same as an electric lamp or an electric fan motor.

The cost of operating such an outfit is trifling, as at the ordinary rates charged for an electric light current of 20 cents per 1000 watts,



ELECTRICALLY-OPERATED AIR PUMP.

it would cost less than one-fourth of a cent to pump this tank of air up to 20 pounds pressure.

The motor is of the Emerson Electric Manufacturing Company's regular type of small power motor which has a half-inch hardened steel shaft, and for such a use as this will last indefinitely.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a general hardening of time money rates, and loans were held at an advance of ½ per cent or more from the figures of the previous week. Thirty to 60-day arrangements are quoted at 3½ per cent, but 90-day loans are 4 per cent, and six-months money 4½@5 per cent. The offerings of time money were less free. Call money is abundant at 1½@2 per cent. Commercial paper is quiet, transactions being based on 4½@5 per cent for prime double names. In the stock market reactionary tendencies were manifest, the greater activity representing speculative liquidation, with renewed bear selling and declines in the general list. The uncertainty of the result of the approaching presidential election naturally produces conservatism on the part of financial houses and the stock market generally. Much interest naturally centred in the movement of the coalers in view of the strike in the anthracite region, and there was some disposition to bull the soft coal stocks. The granger stocks, while showing some disposition to rally from declines, suffered proportionately with other parts of the general list, and more or less attention was paid to the reports that the curtailed winter-wheat crop will now begin to make a more positive impression upon railroad earnings in the Northwest. In common with the general market, electric stocks showed weakness and all of them closed with net losses in prices, as follows: General Electric, 3 points; Brooklyn Rapid Transit, 2½; Metropolitan St. Ry., 3. Most of the inactive list also closed at lower quotations. The sales for the week were: Brooklyn Rapid Transit, 112,818 shares; General Electric, 2930; Metropolitan Street Railway, 16,980, and Western Union, 1818. Outside securities declined in price, due to liquidation, and the market was lifeless. Practically all of the electric stocks were weak and dull, quotations showing losses of from 1 to 5 points. The following are the closing quotations in New York, Boston and Philadelphia:

NEW YORK.

	Sept. 15.	Sept. 22.		Sept. 15.	Sept. 22.
Gen. Elec.	138	135	Elec. Veh.	20	17
Bklyn Rap. Tran.	52½	50	Elec. Veh., pfd.	..	50*
Met. St. Ry.	140½	146½	Gen. Car.	6½	5
Am. Tel. & C.	..	87	Ill. Elec. Veh. Tran.	1¼	1⅛
West. Un. Tel.	79½	78½	N. Y. Elec. Veh. Tran.	7½	7
Am. Dist. Tel.	25	25	N. E. Elec. Veh. Tr.	3½	3
Com. Cable	168	160	Tel., Tel. & Co. of Am.	6	6
Elec. Boat	17	13	Hud. Riv. Tel.	116	116
Elec. Boat, pfd.	30	30	N. Y. & N. J. Tel.	160	160

BOSTON.

	Sept. 15.	Sept. 22.		Sept. 15.	Sept. 22.
New Eng. Tel.	..	..	Erie Tel.	97	97
Mex. Tel.	2	..	Gen. Elec., pfd.	140*	..
Westing. Elec.	48*	..	Am. Tel. & Tel.	142	138½
Westing. Elec., pfd.	65	..	Ed. Elec. Lt.	..	..

PHILADELPHIA.

	Sept. 15.	Sept. 22.		Sept. 15.	Sept. 22.
Elec. Stor. Bat.	64	61	Phil. Elec.	2½	2½
Elec. Stor. Bat., pfd.	90	..	Pa. Elec. Veh.	..	..
Elec. Co. of Am.	9¼	8⅛	Pa. Elec. Veh., pfd.	..	..
Gen. Elec. Auto.	¼	¼	Am. Rys.	..	..

*Asked.

TELEGRAPH-TELEPHONE TRUST.—The foolish reports which consolidate all the telegraph and telephone interests in the country into one "big" trust found their way into print again last week. They were long since noted in these columns. The idea that these interests could be bought up for the paltry sum of $55,000,000 is too funny. "It is to laugh," as the actor says. About $250,000,000 might touch it, or perhaps a little more. Mr. Russell Sage, in regard to the rumor, says: "The reports of this combine have been in circulation for a long time. Just now I can only say that we have talked the matter over informally, but there has been no definite or written proposition presented by either side. I attended a meeting this week of the executive committee of the Western Union Company, of which I am one of the members. The question came up at the meeting, and I asked General Eckert if there was anything new in the talk of a consolidation, but he reported there was not. We agreed that the spreading of rumors of an immediate combine at this time was for the purpose of stock jobbing." Vice-President Baker, of the Postal Telegraph Company, said that all of the talk of consolidation comes from the National Telegraph & Telephone Company, and has never been seriously considered by the Postal Telegraph Company. A despatch from Boston says: American Telephone & Telegraph Company stock at 137½ is practically $275 for Bell, which has declined over 100 points within eight months. Considerable pressure is being brought to bear upon the security, and it is believed that a large interest in the corporation is gradually slipping away to New York, and that the successors to the Telephone & Telegraph Cable Company of America (the new telephone and telegraph company) are acquiring an interest in the American Telegraph & Telephone Company, with a view of obtaining control and to combine their purchases with the Erie purchase and other corporations on which they hold options, in making upon the foundation of the National, which will ultimately own all the telephone, telegraph and cable properties of the country.

THE BOSTON ELECTRIC LIGHT COMPANY has filed the following certificate of its condition June 30 with the Secretary of Massachusetts: Assets—Land and buildings, $1,279,550; machinery, lines, etc., $3,716,595; cash and debts receivable, $243,573; stock in process, $78,930; miscellaneous, $11,000; total, $5,329,648. Liabilities—Capital stock, $3,000,000; debts, $1,777,156; balance to profit and loss, $552,492; total, $5,329,648.

DIVIDENDS.—The E. W. Bliss Company has declared its regular quarterly dividends of 2 per cent on the preferred and 2½ per cent on the common stocks payable Oct. 1. The directors of the Louisville City Railway have declared a 1 per cent quarterly dividend on the $3,500,000 of common stock, and a semi-annual dividend of 2½ per cent on the $2,500,000 of preferred stock. Both dividends are payable Oct. 1.

COLUMBUS, OHIO.—The Columbus, London & Springfield Electric Railway Company has increased its capital stock from $100,000 to $1,000,000. The company is pushing the road to completion in this city, and has about completed its line from Dayton to Urbana. The purpose is to connect the Columbus line with the Dayton line at Springfield.

THE CUTTER-HAMMER MANUFACTURING COMPANY, manufacturer of electric controlling devices, which has recently effected a combination in its line, has increased its capital stock from $150,000 to $200,000.

PHILADELPHIA BELL TELEPHONE STOCK.—The Bell Telephone Company, of Philadelphia, has listed on the Philadelphia Stock Exchange $1,000,000 additional stock. This is part of the $2,000,000 increase authorized by the stockholders.

Commercial Intelligence.

THE WEEK IN TRADE.—There was some irregularity in the general trade situation last week, due largely to the effect of the coal miners' strike and the threatening wage disputes in the iron trade. On the other hand, the course of staple prices was generally upward. Bank clearings reflect the expansion in fall trade in a further gain in volume, and gross railway earnings continue to show gains over the heavy business of last autumn, but much of these are being absorbed by the increased cost of operating. The market for iron and steel is, on the whole, quieter. Copper was very quiet and prices are unchanged, Lake Superior ingot being quoted at 16¾c. to 16⅞c.; electrolytic and casting stock, 16⅝c. The machinery market is very quiet, the only business done last week being that which was "scared" up. The failures for the week, as reported by *Bradstreet's*, numbered 183, as against 167 for the week previous, 147 the same week last year and 182 in 1898, 237 in 1897 and 321 in 1896. Two-thirds of the anthracite coal miners and of the anthracite production are reported idle, as a result of the strike for higher wages and the recognition of the workers' union, and retail prices have advanced considerably. While there is no scarcity yet, many concerns are considering the advisability of preparing to use soft coal in case of a prolonged struggle between miners and operators and a consequent scarcity of anthracite. The Edison station in Duane Street, New York, is already experimenting with soft coal, and the great volumes of black smoke pouring out of the two smokestacks may be the forerunners of a general pollution of New York's usually clear atmosphere. The gross earnings of 112 roads for July aggregated $85,885,039, a gain of $5,430,970, or 6.7 per cent, while the net returns of the same roads were only $26,127,441, a gain of only $137,622, or one-half of 1 per cent. Some curious contradictions are shown in the returns. The central-western roads gained 11.8 per cent in gross but loss 3 per cent in net, while, on the other hand, the southwestern roads gained 17.6 per cent in gross and nearly double this in net. For the second week of September the earnings of 56 roads aggregate $8,743,021, a gain of 5.5 per cent over last year.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Sept. 19: Antwerp—23 cases electric material, $1,568; 8 packages electric machinery, $378; 6 cases motors and parts, $257. Argentine Republic—253 packages electric machinery, $16,712; 293 packages electric material, $14,643. Brussels—18 cases electric material, $1,170. British Australia—5 cases electric material, $261; 1 case electric machinery, $625. Brazil—10 cases electric material, $156. British Guiana—16 cases electric material, $424. Cuba—1 case electric material, $85. Copenhagen—1 case electric material, $11; 7 packages motors, $1,350. Central America—103 packages electric material, $2,515. Christiania—1 box motor cars, $350. Cartagena—23 cases electric machinery, $4,171. Ecuador—1 case electric material,

$23. Genoa—1 case electric machinery, $42. Havre—68 cases electric material, $3,638; 1 case electric machinery, $42. Hamburg—38 cases electric machinery, $7,215; 68 cases electric material, $6,352; 4 packages trolley poles, $82. Helsingfors—1 motor car, $275. Hayti—5 packages electric material, $37. Hull—3 boxes motors and parts, $111. London—119 packages electric machinery, $5,427; 347 cases electric material, $12,681; 68 boxes motors, $5,918; 3 crates automobiles, $2,300. Liverpool—2 packages electric machinery, $50; 62 cases electric material, $1,072; 6 cases motors, $1,080. Mexico—17 cases electric material, $999. Manchester—26 packages electric material, $5,466; 8 packages electric machinery, $3,000. Newcastle—16 boxes motor machinery, $1,595. Naples—1333 packages electric machinery, $72,856. Peru—32 cases electric material, $1,134. Preston—1 case electric material, $191. Riga—38 packages electrical material, $3,744. Southampton—16 cases electric material, $2,416. Stockholm —1 box motor cars, $350. Salonica—1 case electric material, $10. U. S. Colombia—35 cases electric material, $1,216; 37 packages electric machinery, $1,500; 17 cases electric material, $258.

E. B. LATHAM & CO., of 136 Liberty Street, New York, manufacturers and dealers in electrical supplies and specialties, record a rapid and steady growth in their foreign trade. In addition to regular and frequent shipments to England, France, Germany, and to Cuba, Mexico, Brazil and the Argentine, they have during the past couple of weeks supplied an electric power transmission plant for Mexico, large shipments of ceiling and desk fans for the Philippines and Java, and fans and miscellaneous supplies for Belgium, Egypt, South Africa, Australia, Ceylon, India, Siam, Hongkong, Honolulu, Guatemala, Peru, British Guiana and Porto Rico. Their foreign business has, in fact, become of such importance as to warrant the organization of a special export department, and arrangement has been made with Mr. E. F. Colyer, who is well known in the electrical export trade, to take charge of this branch. Mr. Colyer, who has for the past two years been manager of the New York office of the South American Electric Company, and who was formerly connected with the foreign department of the General Electric Company, the Mexican General Electric Company and the South American General Electric Supply Company, is especially qualified to give proper attention to the affairs of the export department, being thoroughly familiar with conditions governing in the field covered. He has traveled extensively, and in addition to speaking Spanish and French, has a working knowledge in one or two other languages.

ELECTRICAL WIRE CONSOLIDATION.—An important deal has been effected between the Washburn Wire Company and the American Electrical Works, of Providence, R. I. The latter company will retain its organization, property and officers as heretofore, and will continue business in the same way. The Washburn Wire Company has acquired an interest in the American Electrical Works, and the stockholders of the American Electrical Works have acquired a large interest in the Washburn Wire Company. The officers and directors in the two companies are: American Electrical Works: Frank N. Phillips, president; E. Rowland Phillips, vice-president; C. H. Wagenseil, treasurer; C. R. Remington, Jr., secretary; Eugene F. Phillips, general manager. Directors—Eugene F. Phillips, Chas. R. Remington, Jr., E. Rowland Phillips, Chas. G. Washburn, Edwin A. Smith, Frank N. Phillips, C. H. Wagenseil, John D. Curtis, Robert Winsor. Washburn Wire Company—Chas. G. Washburn, president; Eugene F. Phillips, vice-president; Joseph Remick, treasurer; John D. Curtis, general manager. Directors—Chas. G. Washburn, John D. Curtis, Eugene F. Phillips, Robert Winsor, Edwin A Smith. The works at Phillipsdale will be greatly enlarged and equipped with a complete steel and iron wire plant. This, with the large factories at 118th Street and Harlem River, New York, owned by the companies, will give the best facilities for the production of bare and insulated copper wire, also steel and iron wire of all kinds.

MR. H. WARD LEONARD has, we learn, completed arrangements for developing in France and England his system of electric traction, and has sold his French patents to the Société Anonyme de Locomotion Electrique, which has appointed him its consulting engineer, a two years' contract having been entered into. This company, with a capital of four million francs, has made, in connection with the Western Railway of France, exhaustive tests with many different types of locomotives, including one built on the Ward Leonard system. At St. Germain a trial track was built, 3½ km in length, with a grade of about 1 per cent and some sharp curves, for carrying on tests. Two years ago the locomotive in question was constructed, practically as described by Mr. Ward Leonard in a paper read before the American Institute of Electrical Engineers in 1891. The locomotive weighs about 32 tons, was equipped with four 80-hp motors, and hauled four cars weighing 100 tons. A speed of 90 km per hour was readily attained, even on this short track. Since that time many improvements have been made in the system, but the old locomotive is still in first-class condition, and has given perfect satisfaction. The English patents will be pushed by Mr. Henry Edmonds, president of Glover & Company, and by Messrs. Geipel & Lange, of London.

THE ALDEN ELECTRIC COMPANY has recently been incorporated by the parties interested in Alden & Company, electrical supply dealers, in Chicago. The new company has rented the building at 52-54 Van Buren Street, Chicago, and is moving there from its former offices in the Marquette Building. The new quarters have 13,000 ft. of floor space, most of which will be used for carrying a good stock of electrical supplies. The business of Alden & Company will be continued by the company on a larger scale. Pittsburg transformers and Lea arc lamps are prominent among this company's agencies, and the agency for Johnson & Morton, Utica, N. Y., has been added recently. The officers of the company are the same as for the Illinois Insulated Wire Company, viz.: Fred H. Alden, president, and J. Geiserowich, secretary and treasurer. The offices of the Illinois Insulated Wire Company will be in the new quarters also. The latter company recently sold the weatherproof wire for the city plants at Galena and Galesburg, Ill., and also the important order from the new city lighting company of St. Louis, consisting of 150,000 lbs. of weatherproof wire to be used on the new city lighting contract.

THE NEW YORK TELEPHONE COMPANY.—This progressive company has recently issued a booklet which gives a fund of information regarding its service in Manhattan, The Bronx, Westchester and Rockland Counties. The scope of this vast business may be appreciated from the fact that the latest telephone directory issued by the company shows that there are 90,000 subscribers to its service in New York City and the immediate vicinity. From the pages of the booklet we learn that each directory issued by the company (quarterly) contains between 3000 and 4000 more names than were contained in the previous issue; that the number of stations in the Boroughs of Manhattan and The Bronx is now nearly 50,000, and that the increase in the number of stations in these boroughs is at the rate of over 1000 a month. The metropolitan system of the New York Telephone Company is said to be the largest telephone system in the world.

CANAL OPERATION.—A special despatch of Sept. 21 from Pittsburg says: "Mr. Thomas N. Fordyce, of Detroit, is in this city and will enter into a contract with the Westinghouse Electric Company for electrical machinery and supplies aggregating $600,000. Mr. Fordyce is the representative of Eastern capitalists who have a franchise from the Board of Public Works of the State of Ohio for the building of an electric railroad along the Miami Canal from Cincinnati to Lake Erie, a distance of 244 miles. The plan, as proposed by the company, and approved by the Board of Public Works, is the construction of a standard gauge railroad on the bank of the canal, and upon it to run electric motors, and instead of hauling cars upon the rails, to haul long strings of boats in the canal." This scheme has been under discussion for some time and it will be interesting to see it carried out.

STEARNS AUTOMOBILE COMPANY.—Some months ago the Stearns bicycle people, of Syracuse, N. Y., began experimenting with an electric automobile, which was illustrated in these pages. We are now advised by Mr. E. C. Stearns that the Stearns Automobile Company has been formed with a capital stock of $1,000,000 for the manufacture of vehicles of the hydrocarbon type, with himself as president, and W. W. Gibbs, of chloride accumulator fame, of Philadelphia, as vice-president. This new company succeeds to the American and Canadian rights of the patents owned and controlled by the Anglo-American Rapid Vehicle Company, and will enter very extensively upon the manufacture of motor vehicles. It has leased and is now operating the factory plant in Syracuse formerly occupied by the Barnes Cycle Company in the halcyon days of the wheel.

EXTENSION OF ELECTRIC CAB SERVICE.—It is stated that the General Carriage Company proposes to enter more actively into the public transportation field in New York. The New York Electric Vehicle Company also intends to make some important improvements and extensions in its service. The General Carriage Company has now in use forty vehicles of various types, and has recently contracted to handle the passenger cab service of the Baltimore & Ohio Railroad, as was noted last week. It is stated that the company is now negotiating with two other railroads to handle their passenger traffic. It is the intention of the General Carriage Company to organize sub-stations which will operate in the larger cities of the country.

A PACIFIC COAST WIRE MILL.—It is reported from Los Angeles, Calif., that the Palmer Nichols Company, of Providence, R. I., will establish in that city a branch factory for the manufacture of all kinds of electrical wires. It is believed that there will be before long a demand in the Western States, Mexico, South America and the Orient which will equal that enjoyed by the main factory of this company.

SHIPBUILDING PLANT.—The new shipbuilding plant for the Risdon Iron Works, at San Francisco, Calif., will be built by the American Bridge Company, of New York, and will consist of a boiler shop, machine shop and foundry, all of the latest design and most modern description.

General News.

THE TELEPHONE.

MENTOR, OHIO.—The Mentor Telephone Company is preparing to erect a new exchange building.

JOHNSTOWN, PA.—The Johnstown Telephone Company will erect here a new exchange building.

WELLSVILLE, OHIO.—The Central Union Telephhone Company is making an effort to secure a franchise.

DAYTON, OHIO.—The Progress Telegraph Company has made an application for a franchise to run a toll line through Dayton.

ALLIANCE, OHIO.—The City Council has finally granted the application of the Columbiana County Telephone Company for a franchise to operate in this city.

DAYTON, OHIO.—The Progress Telephone Company, of West Milton, has secured a franchise from the commissioners of Montgomery County to erect toll lines in that county.

IRONTON, OHIO.—The Lawrence Telephone Company, of Ironton, has been incorporated. Capital, $24,000. Incorporators: W. B. Seaton, J. L. Anderson, H. Russell, T. L. Collett, F. E. Hayward.

GIRARD, GA.—The Girard Telephone Company has been incorporated, with a capital stock of $2,000. Charles Brigham, J. B. Heath, N. A. Buxton, J. O. Mathews and others are the incorporators.

COLUMBUS, OHIO.—The Athens County Telephone Company, of Athens, has been incorporated. Capital, $15,000. Incorporators: C. L. Jones, G. W. Duffee, W. E. Moler, A. F. Holmes, E. J. Holmes.

COLUMBUS, OHIO.—The Citizens' Telephone Company suffered a heavy loss in a large fire on the north side of the city recently. Cables were damaged and nearly 300 telephones were thrown out of service.

PITTSBURG, PA.—The Federal Telephone Company has purchased the Elizabeth Telephone Company, which has been in operation in Elizabeth, Pa., for over a year as a rival to the Bell Telephone Company.

MASSILLON, OHIO.—The Farmers' Telephone Company, of Massillon, Ohio, has reorganized under the name of the Massillon Telephone Company, and has increased its capital stock from $25,000 to $75,000.

WOODVILLE, MISS.—The Louisiana and Mississippi Telephone & Telegraph Company has been organized, with L. T. Ventress, president; Louis Trager, vice-president and general manager, and William Dilbohm, secretary.

OSAGE CITY, KAN.—The Downs Western Telephone exchange has been organized. The company has commenced work on a line from Cawker City to Stockton and has ordered materials for other lines, making about 150 miles in all.

SPRINGFIELD, OHIO.—The United States Telephone Company has made application for a franchise through the city for a new trunk line from Columbus to Indianapolis. The company is also backing a project for a local independent exchange.

SAN FRANCISCO, CALIF.—The Postal Telegraph Company, San Francisco, is laying its underground wires to conform to the municipal ordinance. Standard Underground cables are enclosed in telephone ducts. The "First District" is already completed.

CONCORD, N. H.—The Sanbornton Telephone Company, of Sanbornton, has been incorporated. Capital, $1,150. Incorporators: J. N. Sanborn, W. D. Sanborn, W. D. Woodman, E. B. Smith, all of Laconia; O. M. Smith, of Wimequam; W. B. Fellows, attorney, Tilton.

KOKOMO, IND.—An independent telephone system has been established in this city, the plant costing upward of $30,000. The system connects with the independent lines throughout the State. Prices for service are reduced 50 per cent, and the citizens are loyal in their support.

OAK HARBOR, OHIO.—The Ottawa County Telephone Company has been incorporated by Homer Metzger, E. D. Harkness, Taylor Fuller and others. The capital stock is $30,000. The company will build lines in Sandusky, Lucas and Wood counties with an exchange at Oak Harbor.

DETROIT, MICH.—There is a possibility that Mt. Clemens may have an independent telephone line at an early date. Several of the business men are interesting themselves in the matter, in view of the recent raise of tolls, and the possibility that rates may go up again in the near future.

KANSAS CITY, MO.—Through a failure to deposit with the city the $50,000 guarantee of good faith required by the franchise ordinance, the Missouri Interstate Telephone Company forfeited the franchise voted it recently. The company asked a 60-day extension of time, but the aldermen refused this. Three other companies have bills for franchises pending.

COLUMBUS, OHIO.—The Central Union Telephone Company is announcing in a number of towns a new party line system, whereby two or more subscribers' stations may be operated on the same circuit, and be enabled to signal the central office without signaling the others. The company claims that this overcomes the objectionable features of the old party line system.

HAGERSTOWN, MD.—The Chesapeake & Potomac Telephone Company will soon commence the erection of a new line to Harper's Ferry, Point of Rocks and other points in Maryland and Virginia. The company also contemplates extending the system from Martinsburg to Winchester. A branch line from this city to Cearfoss and other points in this county has been completed.

BALTIMORE, MD.—Mr. Frank G. Boyd, superintendent of the fire alarm telegraph system, is removing the old desk telephones from the fire engine and truck houses in this city, substituting wall sets for them. The new instruments are operated on the common battery system, and are provided with a device of Superintendent Boyd's design, which protects the instruments from being burned out by lightning or crosses with wires carrying heavy currents. The protective device becomes operative when the receiver is hung up on its hook. Mr. Boyd is also introducing a system of house-to-house connections between fire engine houses (also of his own design), which will facilitate the location of breaks or trouble on the circuits.

ELECTRIC LIGHT AND POWER.

CUMBERLAND, MD.—The city will enlarge the municipal lighting plant.

PEMBROKE, KY.—Walter S. Bumbus will build an electric light plant here.

LA GRANDE, ORE., is making arrangements to resume electric street lighting.

MARION, VA.—The city has granted a franchise to a company for the erection of an electric light plant.

HENDERSON, N. C.—The Seaboard Knitting Mills will put in an electric light plant. The contract has been let.

HALLETTSVILLE, TEX.—The Dallas Electric Light Company will install a new plant to supply 1200 incandescent lights.

TORONTO, ONT.—Tenders have been invited by the Corporation of East Toronto, Ont., for the erection of a new electric light station.

PORTLAND, ORE.—The Portland General Electric Company supplied 5000 electric lights in the grounds at the Street Carnival in Portland, Ore.

ABBEVILLE, LA.—M. T. Lewman & Company, of Mobile, Ala., have made a proposition to the city for the erection of a $42,000 water and electric light plant.

HIBBING, MINN.—The village councilmen have authorized the expenditure of $1,200 to increase the power of the electric light works. The authorities will add another dynamo.

CLINTON, S. C.—A company is being formed to install an electric light plant and water works at this place. For further information address Charles E. Moody, Clinton, S. C.

KANSAS CITY, MO.—The Howard Electric Company, capital stock $20,000, has been incorporated by James H. Howard, W. P. Robinson, Jr., W. L. P. Offenbarger and others.

ST. CATHARINES, ONT.—The Corporation of the city of St. Catharines, Ont., is about to undertake the development of additional water-power from the Welland Canal, above Thorold.

DYERSBURG, TENN.—The city will grant a franchise for water works and electric plant, plans for which have been prepared. Address W. A. Fawlkes, mayor, for further information.

SPRINGFIELD, ILL.—The Westville Electric Light & Power Company, of Danville, has been incorporated. Capital, $20,000. Incorporators: M. Kelly, M. W. Kelly, E. K. Kelly, all of Danville.

ROCKVILLE, IND.—Fire destroyed the electric light plant in this city on Sept. 17. The loss is $12,500, with small insurance. The plant is owned by the city. A new plant will be constructed at once.

SOUTH BEND, WASH.—The South Bend Electric Company recently completed a new dam near South Bend, Wash. It will impound 250,000 gallons of water, and will give a working head of 475 ft.

CORNING, N. Y.—The Corning Light & Power Company has been incorporated. Capital, $50,000. Incorporators: W. K. Archbald, F. N. Waterman, both of New York City; P. T. Brady, of Syracuse.

SAYVILLE, N. Y.—The contract for the power house and all of the buildings to be erected on the grounds of the Sayville Electric Light & Power Company nas been awarded to William Bason & Sons, of this place.

NILES, OHIO.—The Niles Electric Company's plant has been sold by Receiver Hurlbert to J. H. Orwing for $1,500. Some time ago it was sold to Elmer Wilson for $8,000, but the latter failed to produce the money.

ALMONTE, ONT.—The Council has decided to submit to the ratepayers of the town a by-law for raising a sum of money to install an electric light plant in the town. The vote will be taken at the end of October next.

SHAMOKIN, PA.—The Shamokin & Coal Township Light & Power Company has been incorporated. Capital, $40,000. Incorporators: E. M. Leader, T. Gillespie, M. G. Stief, F. C. Bard, C. L. Sowers, all of Shamokin.

JEFFERSON CITY, MO.—At a special election, held Sept. 18, the proposition for municipal ownership of electric light plant was lost. Another proposition will immediately be submitted and it is thought that it will be carried.

ZANESVILLE, OHIO.—A Boston syndicate, represented by the International Trust Company, has secured a controlling interest in the Zanesville Electric Light Company's plant. Mr. John Hoge remains as president of the company.

THE DALLES, ORE., is negotiating with the local electric lighting company with a view to having the streets lighted again. On account of a disagreement between the town authorities and the company there has been no street lighting service for serveral years.

BURNS, ORE., will be supplied with electric light and power from a plant to be installed near the falls of the Silvies River, 1½ miles from the town. Local capital will be invested in a combination electric light and water-works plant, to be operated by water-power.

SHERBURNE, MINN.—The Sherburne Electric Light Company has been incorporated. Capital, $15,000. Incorporators: F. H. Brundage, E. Brundage, both of Malta, Ill.; D. M. Reynolds, F. R. Brundage, J. McGovern, G. R. Harnden, W. F. Brundage, all of Sherburne.

HOOSICK FALLS, N. Y.—The Hoosick Falls Electric Company has been incorporated. Capital, $5,000. Directors: Willis E. Heaton and Ezra Tiffany, Hoosick Falls; George W. Davenport, Winchester, Mass.; Owen D. Young, Cambridge, Mass.; Clarence N. Greey, Boston.

HUNTINGTON, QUE.—Messrs. Boyd & Company, of Huntington, Que., have been given a contract to furnish electric light to this town for 20 years. The firm agrees to develop 1000 horse-power, install a 1000-light dynamo and to have the works completed by the first of January next.

WELDON, N. C.—The Roanoke Navigation & Water Power Company has developed a water-power and contracted to supply 500 electrical horse-power for operating a textile mill by January. A contract for a duplicate 500-hp plant will probably be made when the present contract is completed.

CHARLOTTETOWN, P. E. I.—A special committee of the Council of the city of Charlottetown, P. E. Island, has been appointed to obtain information in respect to the cost of a municipal electric lighting plant for the city. An estimate already received places the cost in the neighborhood of $20,000.

RICHMOND, IND.—Members of the City Council of Richmond have been on a junketing trip visiting and examining electric light plants, with a view of introducing municipal lighting at Richmond. It is said there is a division of sentiment relative to the advisability of the city establishing a plant.

CAYUGA, ONT.—The electric light station here was recently destroyed by fire, and the ratepayers of the town have appointed a committee to investigate and report as to the desirability of operating a lighting plant under municipal ownership and control. The most modern dynamos will be secured.

LLANO, TEX.—The Llano Water, Light & Power Company proposes to enlarge its plant by the addition of a 50 or 60-kw, three-phase generator. It will need a few 5 to 15-hp synchronous motors to work from the generator. Line material is also needed by the company. Mr. Charles Schuwirth is the manager.

PHILADELPHIA, PA.—The General Light & Power Company of this city has been incorporated to do a general electric light and railroad business. Capital, $5,000,000. Incorporators: M. J. Hogan, T. J. Begley, T. F. Daley, L. H. Cohen, A. Preston, all of Philadelphia, Pa.; J. A. Quinn, attorney, Philadelphia, Pa.

IOLA, KAN.—The contract for building Iola's electric lighting plant was let to E. M. Reed & Company, of Kansas City, Mo., who bid $8,294.10. The specifications call for an 80-arc light dynamo, 60 enclosed arc lights, a 75-hp Ideal engine, 300 30-ft. poles and 55,000 ft. of wire. Work on the plant will commence at once.

CHIHUAHUA, MEXICO.—A former American consul has promoted a scheme for the generation of power on the San Juan branch of the Concho River. A company has been incorporated under the laws of Illinois, with a capital of $1,000,000, and when the work is completed it is estimated that 6000 to 10,000 horse-power can be produced. The electric energy will be transmitted to Peral, 40 miles, and to Chihuahua, 80 miles.

TELLURIDE, COLO.—The Telluride Power Transmission Company is building an addition to its plant, which will make it the largest electric plant in Colorado. The generating plant at Ames will be doubled, and it is expected that by Jan. 1 the plant will be ready to deliver 4000 horse-power with a certainty of enough water to keep up this supply at any season of the year. Several mines in Ouray will be supplied with power from this plant, among them the Camp Bird, which will be equipped with a complete electrical plant. Everything about the mine and mill will be operated by electricity, and the mine will require 400 horse-power from the Ames plant.

THE ELECTRIC RAILWAY.

LLANARCH, PA.—The power house of the Philadelphia & Westchester Traction Company, at this place, was destroyed by fire recently.

HARRISBURG, PA.—The Arcadia & Clifton Heights Railroad Company has been incorporated to build a road two and one-half miles long in Delaware County. Capital, $52,000.

TROY, N. Y.—The Greenwich & Schuylerville Electric Railway Company has filed notice with the Secretary of State of a proposed change in route in its extension to Fort Edward.

WABASH, IND.—The City Council of Peru has granted a franchise to the Wabash River Traction Company for an interurban line between this city and Peru. Work will begin at once.

TROY, N. Y.—The Schenectady Railway Company has filed notice with the County Clerk that it proposes to extend its lines from Schenectady through Colonie to the Albany city line, a distance of about 40,000 ft.

CHARLESTON, W. VA.—The Grand Rapids Company and the General Light & Power Company, each with a capital of $5,000,000, the former to do a general railroad and telegraph business and the latter to engage in electric and railroad enterprises, have been incorporated here.

ASHEVILLE, N. C.—The Asheville Electric Company has bought out the Asheville & Biltmore Street Railway and is now in control of the entire electrical interests in Asheville. The deal was consummated through J. H. Cutler, representing Eastern capitalists. The consideration was about $50,000.

BRIDGETON, N. J.—At the annual meeting of the Bridgeton & Millville Traction Company D. J. Sullivan, of Philadelphia, was elected president and S. L. Tingley, secretary and treasurer. The old board of directors was re-elected. The company will next spring extend its lines from Cedarville to Port Norris and Bivalve.

TORONTO, ONT.—A threatened strike of street railway men in Toronto has been averted by a compromise. The men, who are getting 16 cents an hour, asked 20 cents. President Mackenzie offered 17 cents to those who had been two years in the company's employ, and 18 cents to those of five years' service. This offer was accepted.

JERSEY CITY, N. J.—President David Young, of the Jersey City, Hoboken & Paterson Street Railway Company, announces that the company will at once proceed to lay a new trolley line from the Hoboken ferry at Fourteenth Street to Hackensack, N. J. The consent of the various municipalities to be traversed will be secured.

SPRINGFIELD, MASS.—The Springfield Street Railway Company has petitioned the board of railroad commissioners to allow an increase in the capital stock to $750,000 for the purpose of liquidating the indebtedness contracted in extending and improving its road and buying equipment, also for buying land and increasing the power plant.

WHITEHALL, N. Y.—The Whitehall & Granville Railroad Company, of Washington County, a street surface railroad, to be operated by electricity or other power, except locomotives, capital $750,000, has been incorporated. The road will run from Whitehall to Granville, a distance of about 14½ miles. Several branches are to be built and maintained to connect with the Delaware & Hudson tracks, making in all a total mileage of 20½ miles.

PITTSBURG, PA.—The Creighton, New Kensington & Springdale Electric Railroad Company, of New Kensington, Pa., has let the initial contract to Edgar A. Tennis, of Philadelphia for what is intended to form a regular network of electric railroads in that part of Westmoreland County, Pa. These lines are expected to be connected with the tracks of the Consolidated Traction Company, of Pittsburg, and extend up along the Allegheny River to Freeport and Kiskimenatas Junction.

TAMAQUA, PA.—The operation of cars on the Tamaqua & Lansford Street Railway was interfered with in a remarkable manner recently. At Ryan's Hill, for a distance of 300 yards, millions of potato bugs had charge of the road, and their crushed bodies under the wheels had such an oily effect that it was only by the most lavish use of sand that the cars could make any headway. The entire gully was covered with the pests, and as fast as the cars had cleared the tracks the path was immediately filled with recruits.

WHITE PLAINS, N. Y.—The Union Railway Company, of New York City, has completed arrangements to make some important extensions in Westchester County immediately. The line from White Plains will be extended to Mt. Vernon through Tuckahoe, Bronxville, Scarsdale and Hartsdale. With the line running now through to Larchmont, and there connecting with the road to Mamaroneck and Port Chester, the company will have a complete belt line of the county from the Hudson River to the Sound, a distance of nearly 40 miles.

TORONTO, ONT.—Ald. Lamb, chairman of the City Board of Works of Toroton, Ont., reports that he has received satisfactory assurance from New York that a company to build a radial electric railway system, tributary to Toronto, would be financed in the city of New York. He urges, however, that Canadian capitalists take control of the enterprise and raise the $5,000,000 required to carry out the work. The scheme involves the construction of almost 500 miles of trolley lines, the chief one giving Toronto connection with Georgian Bay and Lake Simcoe.

WILMINGTON, DEL.—James W. and Daniel B. Shepp, of Norristown, have brought suit against the Schuylkill Valley Traction Company and the United Power & Transportation Company to enjoin the United Power & Transportation from further management of the road and to have a receiver appointed. The suit is brought on the ground that the transportation company is violating the Pennsylvania law, which forbids a transportation company from engaging in any business except that of a common carrier, by operating electric light plants at Lebanon, Reading and other places, and also on the ground that the company has not complied with the law.

NEW YORK CITY.—In order to provide additional terminal facilities for its various lines the Metropolitan Street Railway has begun to make the necessary changes in its Park Row tracks opposite the post office. The Metropolitan tracks and those of the Third Avenue line will be connected with those of the Broadway line in front of the post office. The work of preparing the Broadway cable line for the use of the electric system was completed, so far as the work on the street itself is concerned, on Sept. 20. The change from cable to electricity will not, however, be made until next spring, according to a statement made by President Vreeland, as there is still a great deal of work to be done.

THE AUTOMOBILE.

THE NEW HAVEN ELECTRIC CAB COMPANY, New Haven, Conn., it is reported, proposes to retire the trolley car, placing in its stead the automobile. The company was incorporated last fall, with a capital stock of $60,000.

AUTOMOBILE PATROL WAGON.—An automobile patrol wagon will soon be installed at one of the stables of the police department in St. Louis. The police officials have taken the matter up, and will follow the example of New York and Boston.

AUTOMOBILE MAIL WAGON.—An automobile, especially adapted to carrying mail over sandy roads, has been received in Challis, Idaho. It will be operated by E. A. Readicker, who has a mail contract, and an average speed of 10 miles an hour will be maintained with a gasoline motor.

THE WESTCHESTER AUTOMOBILE CLUB was organized at White Plains, N. Y., on Sept. 13. The club is a social organization, the object of which is to promote the interests of those interested in automobiling and those who use self-propelling vehicles for private purposes, and to arrange for repair shops and depots of supplies at various points, as funds may allow, for the convenience of its members. Among those interested in the club are John D. Archibald, A. W. S. Cochrane, Oliver Harriman, Jr., H. J. Luce, B. B. McGregor, Trenor L. Park, E. S. Reynal, N. C. Reynal, Paul G. Thebaud and Howard Willets.

PERSONAL.

MR. AUGUST ZIESING has been appointed general Western representative of the American Bridge Company, with headquarters at Chicago.

MR. W. D. BALL, of Chicago, who has been electrical engineer for the U. S. Commission at the Paris Exposition, has returned home and resumed his practice as a consulting engineer.

BELL.—The engagement is announced from Washington of Gilbert Hovey Grosvenor, son of Prof. Edwin A. Grosvenor, of Amherst College, and Miss Elsie Graham Bell, daughter of Alexander Graham Bell, LL.D., of Washington, D C.

MR. GEORGE H. BLAXTER, who is well known in electrical circles throughout the country, he having been at one time the general manager of the Allegheny County Light Company, Pittsburg, Pa., and the Brush Electric Light Company, Baltimore, Md., has been elected president of the Atlantic Tube Company, Pittsburg, Pa.

EDUCATIONAL.

THE UNIVERSITY OF THE STATE OF MISSOURI, in a recent bulletin, briefly describes the resources and course of study at the school of engineering at that institution. This university is located at Columbia, Mo.

THE EVENING SCHOOL OF ELECTRICITY, under the direction of the Harlem Branch of the Young Men's Christian Association, at 5 West 125th Street, New York City, will open for its third season during the first week in October. The school will be in charge of Mr. S. A. Small, assistant instructor in electricity at Columbia College, and a man who is thoroughly practical, having seen active service in electrical work. The sessions will be held on Tuesday and Friday evenings, and the course will consist of 48 lectures. Mr. Small will commence by thoroughly grounding the class in the fundamental rules and principles of electrical engineering, and during the course will cover fully the various branches of the industry. The lectures will be illustrated by diagrams thrown upon the screen by means of a powerful stereopticon, and, in addition to this, a large amount of apparatus will be used in illustrating the work. The opening session on Oct. 2 will be free to all men, and visitors are cordially invited.

Trade Notes.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., is going to move about Oct. 1 to more commodious quarters at the southwest corner of Seventh and Clark Avenue.

PHOSPHOR-BRONZE.—The Phosphor-Bronze Smelting Company, Limited, 2200 Washington Avenue, Philadelphia, Pa., has just issued a revised price list of phosphor-bronze wire, wire ropes and the various products of this company.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, 831 Arch Street, Philadelphia, each month sends out a monthly calendar printed on a blotter. Mr. Roberts will be glad to place the name of any responsible person on his mailing list for these blotters.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is installing in the new blast furnaces of the Lorain Steel Company, Lorain, Ohio, a 300-kw, engine-type generator, 550 volts, 135 r. p. m., direct-connected to a 250-hp Buckeye horizontal engine.

BURT EXHAUST HEADS.—The Burt Manufacturing Company, Akron, Ohio, reports that the demand for Burt exhaust heads is so great as to crowd its producing capacity. This is regarded by the company as being due entirely to the merits of the device, which are being recognized.

WESTERN ELECTRIC COMPANY, Chicago, has just published a 150-page electric fixture catalogue containing a very complete line of stationary and adjustable fixtures, reflectors, metal and glass shades. A large stock of these goods is constantly on hand, and the company is prepared to make prompt delivery.

PACIFIC COAST AGENCY.—John Martin & Company, 31-33 New Montgomery Street, San Francisco, have been appointed selling agents on the Pacific Coast for the Northern Electrical Manufacturing Company, Madison, Wis., under the business agreement formed between the Northern Company and the Stanley Electric Manufacturing Company.

EXPOSITION IN BOSTON.—The Merchants' and Manufacturers' 20th Century Exposition will be held in Mechanics' Building, Boston, Mass., from Oct. 1 to Oct. 27. This exposition is open to all products and manufactured articles known to civilization. It is thought that it will be one of the most noteworthy expositions in the history of New England.

THE SOCKET EXTENSION TAP COMPANY, Boston, Mass., reports very large sales of its new device for taking extra light or power from any incandescent electric lamp socket, without removing the lamp. The Electric Appliance Company, Chicago, has been appointed general western agents, and "Taps" are now being sold by all the electrical supply houses.

AWARD FOR FUSE WIRES.—The Chicago Fuse Wire & Manufacturing Company, Chicago, announces that it has received official notice that a medal has been awarded to it by the International Jury of Awards for its exhibit at the Paris Exposition. The exhibit consisted of a complete assortment of the company's "Trade Mark" line of tested fuse wire and fuse links.

MESSRS. E. B. LATHAM & COMPANY, 136 Liberty Street, New York City, have recently issued a new catalogue, No. 17, illustrating telegraph and telephone instruments, bells, batteries and house-wiring goods generally, which, with previous issues of No. 14, electric light and power supplies, and No. 16, railway supplies, cover the field of electrical enterprise pretty thoroughly.

JAMES J. MURRAY & COMPANY, Trenton Avenue, Waterloo and Culvert Streets, Philadelphia, Pa., manufacturers of the well-known Murray flint-glass globes and shades for all kinds of electrical work, report that they were never busier than at the present time. They have brought out a number of new designs for the electrical trade, a description of which will be mailed upon application.

ELECTRIC DRIVE.—The Dueber Watch Case Company, Canton, Ohio, is preparing to change a portion of its plant to electric drive, and has placed contracts for a Buckeye engine, to be direct-connected to a 75-kw, 200-volt, 250-r. p. m. Westinghouse generator; also 10 motors, as follows: One 20 horse-power, three 10 horse-power, four 5 horse-power, one 3½ horse-power, one 2 horse-power.

G. I. ENCLOSED ARC LAMPS.—A complete description and several excellent illustrations of the G. I. Type L5 enclosed arc lamps are given in a bulletin just issued by the General Incandescent Arc Light Company, New York. These lamps are designed to operate on direct-current series arc circuits. They are finished in various styles, and offered as thoroughly modern and reliable, and of the highest efficiency.

ELECTRIC LIGHT SUPPLIES.—A very complete line of electric light supplies is illustrated in a large, 104-page catalogue and price list (No. 7) just issued by Messrs. Frank H. Stewart & Company, 35 North Seventh Street, Philadelphia. The list is a very complete one and embraces everything in the way of electric light supplies. Any one in the trade may obtain a copy of the catalogue on application.

METAL-WORKING MACHINERY.—The W. F. & John Barnes Company, Rockford, Ill., has just issued a 54-page catalogue describing and illustrating its line of metal-working machinery. Among the machines thus shown and described are drills of various styles, gears, emery grinders, lathes, polishing machines, lathe tools, etc. The catalogue is very complete, and will no doubt be of interest to all concerned in this line of goods.

THE TEXAS ARM & PIN COMPANY, of Beaumont, Tex., writes to us as follows: "We are going through a great rush here now as a result of the storm which swept the country, and while we lost a considerable amount of material we kept things going at our factories and are now supplying the telegraph and telephone companies with an immense amount of material." Thus is enterprise rewarded, even under the most adverse conditions.

THE NEW YORK MOTOR-VEHICLE COMPANY has just finished its model public passenger omnibus, and will have it on exhibition at the Automobile Show, in the restaurant section of Madison Square Garden, Nov. 3 to 10. This company has adopted steam as its motive power. Its model omnibus is made to seat 20 passengers, and differs in style and size from anything so far made in this country. The trade and public will probably be interested to see this vehicle at the forthcoming exhibition.

THE GREGORY ELECTRIC COMPANY.—Since last January the Gregory Electric Company, Chicago, has had extra help at work overhauling its large stock of electrical machinery in its warehouses in Chicago, so that now the great majority of generators, motors, etc., offered by this company are available for immediate shipment. This company never offers for sale any apparatus not actually bought and owned by it. It handles nothing whatever on commission, consequently its customers are always sure of dealing with the owners at first hand, and of prompt delivery.

TURRET LATHES.—Among the best known lathes in the market are those of the American Turret Lathe Company, Wilmington, Del. In a pamphlet lately issued by the company the features of these lathes are brifly pointed out. The pamphlet contains two excellent half-tone illustrations of a 24-in., semi-automatic turret lathe and a 40-in. semi-automatic turret lathe, the latter being, it is said, the largest and most powerful machine of this kind ever built. The semi-automatic lathe has six changes of speed for each speed of the cone pulley, and these speeds can be obtained without stopping the machine.

THE AMERICAN BATTERY COMPOUND COMPANY, Chicago, Ill., manufacturer of American battery compound, a battery salt of superior quality intended to replace sal-ammoniac in all zinc-carbon cells, has removed its office and factory from 31-33 South Canal Street, to more commodious quarters at 224-226 South Clinton Street. This step was made necessary by the rapid growth of the firm's business, which is wholly beyond its expectations. The new factory has a capacity of 15,000 packages of compound per day. The company is now in a position to fill all orders promptly, and would like to correspond with supply houses, telephone exchanges and others now buying sal-ammoniac.

AGEING OF TRANSFORMER IRON.—The General Electric Company is distributing a 92-page pamphlet on the subject of "Ageing of Transformer Iron," containing five important articles that have been issued regarding this subject, as follows: "The Ageing of Transformer Iron," by Prof. W. Elwell Goldsborough; "On Slow Changes in the Magnetic Permeability of Iron," by Mr. W. Mordey; "Effects of Prolonged Heating on the Magnetic Properties of Iron," by Mr. S. R. Roget, B.A.; "Hysteresis in Sheet Iron and Steel," by Mr. Arthur Hillyer Ford, and "The Ageing of Transformer and Steel," by Mr. J. A. Capp. This pamphlet is one that should be in the hands of every central station manager, and will be furnished free of charge upon application to the General Electric Company.

MECHANICAL DRAFT.—In a recent paper on mechanical draft, read before the New England Cotton Manufacturers' Association, Walter B. Snow states that from a comparison of a considerable number of plants it appears that under ordinary conditions a single forced-draft fan with direct-connected engine and short stack can be installed for less than 20 per cent of the cost of a brick chimney; a single induced-draft fan with direct-connected engine and short stack will cost less than 30 per cent of a chimney, and that a duplex induced-draft apparatus, consisting of two fans with direct-connected engines, inlet and outlet connections and short stack, will cost but little more than 40 per cent of a chimney. The latter arrangement is only employed where, as in the case of an electric lighting plant, it is the practice to introduce relay units.

A NEW GALVANOMETER.—Messrs. Queen & Company, Philadelphia, in a pamphlet just brought out, describe and illustrate a new galvanometer, which is designed to have sufficient sensibility and accuracy to meet all ordinary requirements without the elaborate finish of the highest grade instruments. The instrument is of the wall pattern, and is of the D'Arsonval swinging coil type enclosed in a cylindrical case. A bracket carries a telescope and scale, which has all the necessary adjustments. The features claimed for this instrument are: Simplicity of construction, ease of leveling, accessibility of working parts, working quality, proportional deflection, low resistance and high sensibility, permanence of readings and ease of reading. Other apparatus illustrated include the Queen tripod D'Arsonval galvanometer, the Queen-Ayrton universal shunt box, Wheatstone bridge and rheostat, resistance boxes, etc.

ELEVATING AND CONVEYING MACHINERY.—The Jeffrey Manufacturing Company, Columbus, Ohio, has just issued a very complete catalogue of its products, which consist of chain belting, elevators, conveyors, steel-cable conveyors, carriers, labor-saving appliances, mill, factory and mine supplies, power-transmission machinery, coal-washing and mining machinery. The apparatus of these various classes are illustrated, some of them being shown in full size on double folding sheets. The cover of the catalogue is very artistically executed. On the front the globe is represented in relief as being revolved by means of sprocket and chain, and on the back cover is given a bird's-eye view of the company's plant at Columbus, besides illustrations of some of its manufactures. The catalogue has 276 pages, and a copy of it may be obtained on application. The contents will no doubt be instructive and interesting to all who use such devices.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED SEPT. 18, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

657,908. SPEED REGULATOR FOR DYNAMOS; P. W. Alexander, Tifton, Ga. App. filed Feb. 7, 1900. Provides for driving a dynamo at a uniform speed from the axle of a car irrespective of the rate of speed or direction of motion of the axle. The armature shaft is provided with a flywheel and is geared to another shaft also provided with a flywheel, the latter shaft partaking of rotary motion imparted by a reciprocating rod driven by an eccentric on the car axle.

657,910. METALLIC CEMENT FOR ELECTRIC CONDUCTOR JOINTS; W. F. Barbour, Wilkesbarre, Pa. App. filed Feb. 3, 1900. A conducting cement comprising an amalgam consisting of zinc, tin, copper, cadmium, bismuth, lead, antimony and mercury, and a binding material consisting of glucose and silicate of soda.

657,911. APPARATUS FOR SEPARATING METALS FROM ORES BY ELECTRICITY; G. B. Burton, Boston, Mass. App. filed Nov. 1, 1897. An electric furnace comprising a reducing chamber having a short stack surmounting the same, and a bottom separable therefrom, the body of the reducing chamber as well as the bottom being composed of electro-conductive resistance material and each having an electrode connected thereto.

657,937. PROCESS OF MANUFACTURING NITROGEN COMPOUNDS; C. B. Jacobs, East Orange, N. J. App. filed April 7, 1899.

657,938. PROCESS OF MANUFACTURING COMPOUNDS OF NITROGEN; C. B. Jacobs, East Orange, N. J. App. filed Jan. 23, 1900.

657,983. ELECTRIC METER; J. Harris, Lynn, Mass. App. filed July 5, 1899. Details.

657,984. ELECTRIC MEASURING INSTRUMENT; J. Harris, Lynn, Mass. App. filed July 20, 1899. The current to be measured traverses a substantially triangular-shaped coil, the magnetizable arm or body to be moved standing within the triangular opening of the coil normally at the widest part thereof, so that under the influence of the current it will be moved toward the narrowest part of the opening. The arm or body carries or controls the index finger.

658,012.—Dynamo-Electric Machine.

658,012. DYNAMO-ELECTRIC MACHINE; M. H. Hurrell, Wimbledon, Eng. App. filed Feb. 13, 1900. According to this invention the field magnets comprise two series of poles, one series operating upon one peripheral annulus of the armature surface and being all north poles, and the other series operating upon another peripheral annulus and being all south poles, all the poles being joined together by oblique yokes which form a zigzag ring.

658,013. METHOD OF LOCATING CONCEALED WATER PIPES; F. T. Iddings and D. H. Washburn, Washington, D. C. App. filed Dec. 2, 1899. The pipes are charged with electricity and an electric interrupter placed in the circuit. "An explorer" is then passed over the walls until the induced current therein ceases, this indicating that the explorer is immediately over and in line with a pipe.

658,022. MAXIMUM ELECTRICAL CURRENT INDICATOR AND RECORDER; E. C. Rimington, London, Eng. App. filed May 3, 1900. Consists of an apparatus whereby the constant generation of a gas or gases, such as by electrolysis of water by a passing electrical current, is utilized to effect a record of the maximum current that has passed in a predetermined duration of time.

658,027. THERAPEUTIC DEVICE; A. W. Steiger, Boston, Mass. App. filed Nov. 22, 1899. Consists of a series of units, each unit being composed of unlike pieces of metal fitted one within the other to form a disc. Each piece is in contact with the next one, and one of said pieces is a permanent magnet with a metallic circuit.

658,064. SWITCH FOR ALTERNATING ELECTRIC CURRENTS; B. Hopkinson, London, Eng. App. filed Dec. 22, 1899. Provides means whereby the interruption of an alternating electric current is effected automatically at or about an instant at which its value is zero.

658,075. ELECTRIC RAILWAY SYSTEM; W. Robinson, Boston, Mass. App. filed Sept. 22, 1897. Details.

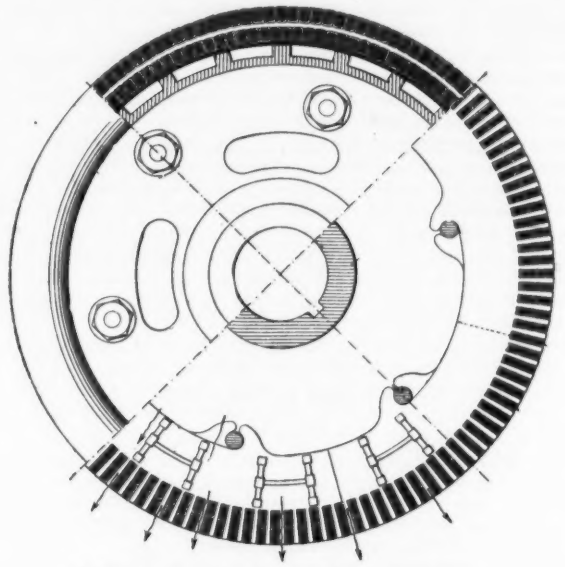
658,100. ARMATURE FOR MULTIPOLAR DYNAMOS; J. J. Wood, Fort Wayne, Ind. App. filed June 14, 1898. Provides for armature ventilation. Ventilating spaces are located between the coils and core and the spiders of the armature, so that currents of air may enter inside the coil and circulate through air-ducts against the core and around the coils.

658,117. AUTOMATIC MAXIMUM SPEED GOVERNOR FOR ELECTRICALLY PROPELLED VEHICLES; Horace Field Parshall, London, Eng. App. filed June 12, 1897.

658,192. ELECTRIC CONDUCTOR; F. C. Sutter, Pittsburg, Pa. App. filed Dec. 30, 1899. A device to prevent liquids from traveling along electric conductors by capillary attraction, which consists in locating in said conductor a solid integral section.

658,197. GAME; R. E. Wickes, London, Eng. App. filed Aug. 3, 1899. A model boat or other floating object is located in a tank of water in which there are imitation rocks or other obstructions. A series of magnets under the tank, being properly operated by the player, guide the boat safely past the obstructions.

658,225. CIRCUIT CONTROLLER; C. C. Webster, Asbury Park, N. J. App. filed Jan. 19, 1900. A controller designed for use in connection with electric signs and adapted to be adjusted or changed so as to direct current to the lamps forming the respective letters of the sign in any desired sequence.



658,100.—Armature for Multipolar Dynamos.

658,235. SECONDARY BATTERY; V. Cheval and J. Lindeman, Brussels, Belgium. App. filed Jan. 19, 1900.

658,238. MOTOR VEHICLE; C. J. Coleman, Chicago, Ill. App. filed Sept. 2, 1899.

658,243. TROLLEY; W. A. Daggett, Vineland, N. J. App. filed May 23, 1900. The trolley wheel is mounted in the upper end of a frame which is connected with the trolley pole by a flat spring so that the wheel may have yielding contact with the conductor wire.

658,282. SIGNAL; J. M. Sailer, Janesville, Wis. App. filed Dec. 15, 1899. A visual signal for telephones. The signal is normally hidden, and is released and exposed to view by the vibration of the striker of the telephone call bell.

658,299. ELECTRIC GAS LIGHTER; H. De Thiersant and H. J. Norballe, London, Eng. App. filed May 14, 1900. Consists of a main burner and a by-pass burner controlled by a valve, the latter being operated by a toothed wheel moved step by step by the vibrating armature of an electromagnet. The first operation of the toothed wheel admits gas to the by-pass, further rotation ignites the same, still further rotation admits gas to the main burner which is ignited by the by-pass flame, while a final rotation of the plug cuts off the gas to the by-pass.

658,301. TELEPHONE RELAY; W. G. Urmson, New Brunswick, N. J. App. filed Feb. 5, 1900. (See page 489.)

658,315. ELECTRIC FURNACE; A. H. Cowles, Cleveland, Ohio. App. filed Oct. 22, 1895. The electric furnace is located between two bodies of carbon, coke or fuel, and a current of air passed through the juxtaposed masses, or a current of mixed air and gas may be pre-heated and passed through the masses; the carbon in either case having a regenerative effect, and with each reversal of the flow of gas therethrough increasing the temperature.

SWEET SIMPLICITY

WHAT COULD BE MORE SIMPLE IN CONSTRUCTION THAN THE MONARC LAMP AND YET, ENCLOSED ARC UNEXCELLED IN EFFICIENCY AND ECONOMY.

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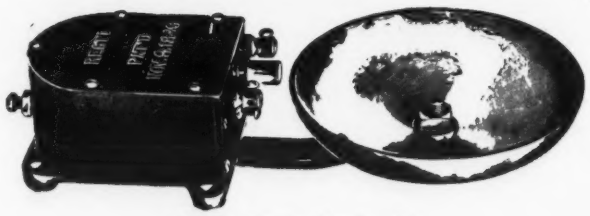

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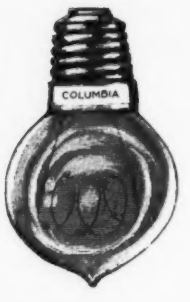

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